CENTRAL UNIVERSITY OF HARYANA

(Established under the Central Universities Act, 2009)

(NAAC Accredited 'A' Grade)

NEP and NCrF/NHEQF based

Curriculum and Syllabi of

Master of Computer Applications (MCA)

(w.e.f. Academic Session 2025-26)

Department of Computer Science and Information Technology

School of Basic Sciences

1. Vision and Mission

i) **Vision and Mission of the University**

Vision

To develop enlightened citizenship of a knowledge society for peace and prosperity of individuals, nations, and the world, through the promotion of innovation, creative endeavors, and scholarly inquiry.

Mission

To serve as a beacon of change, through multi-disciplinary learning, for the creation of a knowledge community, by building a strong character and nurturing value-based transparent work ethics, promoting creative and critical thinking for holistic development and self- sustenance for the people of India. The University seeks to achieve this objective by cultivating an environment of excellence in teaching, research, and innovation in pure and applied areas of learning.

ii) Vision and Mission of the Department

Vision

To be a Centre of Excellence for nurturing computer professionals with strong application expertise through experiential learning and research for matching the requirements of industry and society instilling in them the spirit of innovation and entrepreneurship by providing knowledge of computer systems in both hardware and software application design so that they contribute not only in the progress of software and its application but even encompass the entire emerging domain of computer technology.

Mission

1. To improve high-quality professional training at the postgraduate with an Emphasis on the basic principle of Computer Science and application.

2. To impart value-based, quality education that provides design and development like software applications in their entirety. Innovative learning-centric facilities for solving computational problems.
3. To promote research-based activities through analysis and interpretation of data and synthesis of the information for utilization in resolving practical problems relating to computer applications.
4. To provide help in promote\preparing students to qualify for exams like UGC-NET, GATE, and other competitive exams.
5. To provide a framework through Project Based Learning to support society and industry in promoting a multidisciplinary activity.
6. To provide a quality learning experience through effective classroom practices, the active learning style of teaching, and opportunities for meaningful interaction between students and faculty.
7. To develop a crystal-clear evaluation system and experiential learning mechanism aligned with futuristic technologies and industry.
8. To undertake societal activities for the upliftment of rural/deprived sections of the society.

iii) Mapping of Vision and Mission

Vision and Mission of the University	**Vision and Mission of the Department**
To develop enlightened citizenship of a knowledge society for peace and prosperity of individuals, nations, and the world, through the promotion of innovation, creative endeavors, and scholarly inquiry.	**Yes**
To serve as a beacon of change, through multi-disciplinary learning, for the creation of a knowledge community, by building a strong character and nurturing value-based transparent work ethics, promoting creative and	**Yes**

critical thinking for holistic development and self-sustenance for the people of India.	
The University seeks to achieve this objective by cultivating an environment of excellence in teaching, research, and innovation in pure and applied areas of learning.	**Yes**

2. Background

i) NEP-2020 and LOCF an integrated Approach

Considering the curricular reforms as instrumental for desired learning outcomes, all the academic departments of Central University of Haryana made a rigorous attempt to revise the curriculum of undergraduate and postgraduate programmes in alignment with the National Education Policy-2020 and UGC Quality Mandate for Higher Education Institutions-2021. The process of revising the curriculum could be prompted by the adoption of the ―Comprehensive Roadmap for Implementation of NEP-2020‖ in the 32nd meeting of the Academic Council of the University held on April 23, 2021. The roadmap identified the key features of the Policy and elucidated the Action Plan with well-defined responsibilities and an indicative timeline for major academic reforms.

The process of revamping the curriculum started with a series of webinars and discussions conducted by the University to orient the teachers about the key features of the Policy, enabling them to revise the curriculum in sync with the Policy. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to appreciate and incorporate the vital aspects of the Policy in the revised curriculum focused on creating holistic, thoughtful, creative and well-rounded individuals equipped with the key 21st-century skills for the development of an enlightened, socially conscious, knowledgeable, and skilled nation '.

With NEP-2020 in background, the revised curricula articulate the spirit of the policy by emphasizing upon—integrated approach to learning; innovative pedagogies and assessment strategies; multidisciplinary and cross-disciplinary education; creative and critical thinking; ethical and Constitutional values through value-based courses; 21st century capabilities across the range of disciplines through life skills, entrepreneurial and professional skills; community and constructive public engagement; social, moral and environmental awareness; Organic Living and Global Citizenship Education (GCED); holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning; exposure to Indian knowledge system, cultural traditions and

classical literature through relevant courses offering Knowledge of India‘; fine blend of modern pedagogies with indigenous and traditional ways of learning; flexibility in course choices; student-centric participatory learning; imaginative and flexible curricular structures to enable creative combination of disciplines for study; offering multiple entry and exit points initially in undergraduate programmes; alignment of Vocational courses with the International Standard Classification of Occupations maintained by the International Labour Organization; breaking the silos of disciplines; integration of extra-curricular and curricular aspects; exploring internships with local industry, businesses, artists and crafts persons; closer collaborations between industry and higher education institutions for technical , vocational and science programmes; and formative assessment tools to be aligned with the learning outcomes, capabilities, and dispositions as specified for each course. In the case of UG programmes in Engineering and Vocational Studies, it was decided that the departments shall incorporate pertinent NEP recommendations while complying with AICTE, NBA, NSQF, International Standard Classification of Occupations, Sector Skill Council, and other relevant agencies/sources. The University has also developed a consensus on the adoption of Blended Learning with 40% component of online teaching and 60% face-to-face classes for each programme.

The revised curricula of various programmes could be devised with concerted efforts of the faculty, Heads of the Departments, and the Deans of Schools of Study. The draft prepared by each department was discussed in a series of discussion sessions conducted at the Department, School, and University levels. The leadership of the University has been a driving force behind the entire exercise of developing the uniform template and structure for the revised curriculum. The Vice-Chancellor of the University conducted a series of meetings with Heads and Deans to deliberate upon the vital parameters of the revised curriculum to formulate a uniform template featuring Background, Programme Outcomes, Programme Specific Outcomes, Postgraduate Attributes, Structure of Masters Course, Learning Outcome Index, Semester-wise Courses and Credit Distribution, Course-level Learning Outcomes, Teaching-Learning Process, Blended Learning, Assessment and Evaluation, Keywords, References, and Appendices. The experts of various Boards of Studies and School Boards contributed to a large extent in giving the final shape to the revised curriculum of each programme. To ensure the implementation of curricular reforms envisioned in NEP-2020; the University has decided to implement various provisions in a phased

manner. Accordingly, the curriculum may be reviewed annually.

ii) About subject

Computer plays a significant role in every field of life. They help us in several ways, for example, they find applications in medicine, surgery, industrial process, aviation industry, making bills in various big shops & malls, creating presentation slides in application software for making notes & delivering lectures in colleges, universities, analysis of algorithms, programming languages, program design, development of software and computer hardware and a lot more. In short, not only in just one, but the computer plays an all-rounded role in the field of education of students.

Computer, along with internet facility is the most powerful device that students can use to learn new skills & abilities in education. Innovation in Computer technology has a profound impact on education. It forms a part of the school curriculum as it is an essential part of every individual today. Computer education in schools plays a major noteworthy role in the career development of young students, it becomes an integral part of each student's life. Vast or Immense storage is yet another main great characteristic of a computer. Students and teachers can download and store a lot of educational materials, books, presentations, lecture/ address notes, question papers, and so on. Students can find many different ways to solve a certain problem given to them. Through computers, they can interact with people having the same issues & decisions.

Being actively used in various educational institutes like schools, colleges & big universities, computer centers, computers are used to aid the learning process of students. Professors in colleges & teachers in schools take the help of audio-visual techniques to prepare lesson plans for students. For this, they use Microsoft PowerPoint to prepare electronic presentations about their lectures. These electronic presentations can be shown on multimedia and sound projectors in classrooms. It is an interesting and simple method to learn for students. Multimedia (Sight and sound) presentations are easy to deliver for teachers also as these presentations spare a great deal of time and effort. Computers can be used for online education & research. With the help of the internet, students can find useful information about their projects, and assignments and also can

take useful help from other researchers as they store & organize their research materials on computers. In CBT (Computer Based Training), various projects & educational programs are prepared or set up with the assistance of expert educators and audio-visual media help. These educational programs are generally set up in the shape of lectures on a specific subject/ topic & are given on CDs. Students can learn when they wish at their homes. Using Computer Education students can-

- Enhances creativity & thinking skills
- Proves beneficial for career aspiration
- Design and develop a software application for different industries
- Provides efficient & better use of IT Technology
- Improves research work & helps in communicating with different education providers
- Gives instant information/ Quick processing of data on any topic in just a single click
- Manages the software, hardware & networks in any industry
- Involves in the design and development of the hardware components of PCs & laptops
- Develop software for peripheral computing devices such as printers, modems, scanners, etc.
- Write code and algorithms for operating systems like Windows, Linux, etc.
- Develop design, implementation, and management of information systems of computer hardware and software.

iii) About the Programme (Nature, extent, and aims):

The objective of this report is to propose a curriculum for the 2-year Master of Computer Applications (MCA) course. MCA course is now offered by more than 200 institutions all over India and is an important source of human resources for the software industry. The first MCA curriculum was proposed in 1982 and was later revised by a working group of the Indian Society of Technical Education in 1990. These curricula have been primarily used as guidelines by Universities that have a Board of Studies whose responsibility is to draft curricula. The All-India Council of Technical Education (AICTE), has one of its responsibilities to specify norms and standards for technical institutions. Needless to say, a good curriculum is an essential requirement for ensuring the quality of an academic programme. Thus, the All-India Board of Computer Science. Engg./Tech. and Applications constituted a committee that proposed a draft curriculum

for the MCA degree. In this report, we give the modified curriculum. Information Technology is growing rapidly. Increasing applications of computers in almost all areas of human endeavor has led to a vibrant industry with concurrent rapid change in technology. Thus, the challenge in designing a curriculum is to identify the areas of reasonably stable core competence and provide a sufficient number of electives and laboratories to accommodate changes. Thus, the suggested curriculum has a strong laboratory and project orientation in which the use of new tools will be emphasized. Most courses will have an associated laboratory and it is expected that they will be equipped with the latest software tools. One of the major problems faced by almost all colleges offering MCA, courses is the lack of adequate faculty. This problem has no easy solution as industry jobs are plentiful and very remunerative. This problem can be partially alleviated if good educational material is available to students and Staff covering the curriculum. It will be desirable for colleges to have internet connectivity as the net has plenty of educational material. The objective of the MCA programme is to prepare post graduates for productive careers in the software industry, corporate sector, Govt. organizations, and academia by providing a skill-based environment for teaching and research in the core and emerging areas of the discipline. This Master Degree Programme has been designed with a semester approach in mind. The first-year courses are aimed at skills development in computers using various technologies, core courses that provide conceptual frame work and the second year offer specialization courses, training, and project works.

iv) Qualification Descriptors (possible career pathways)

On successful completion of the MCA Programme, students of the department are expected to work at different platforms in addition to living productive and meaningful lives. Some of the possible career paths for the postgraduate students may be:

1. Software Developer

Software developer develops, tests, installs and maintains brand new software systems for clients. Software developers are as much engaged in recommending upgrades in existing programs as they are in making all the application system pieces work together.

2. System Analyst

A systems analyst is an information technology professional who specializes in analyzing, designing, and implementing information systems. Systems analysts assess the suitability of information systems in terms of their intended outcomes.

3. Data Scientist

Data scientists are responsible for analyzing all the data that is collected to make predictions, understand consumer and market behavior, and overall improve business and customer service.

4. Network Manager

A Network Manager Manage and maintain the network, as well as network performance monitoring, Identifying, installing, and maintaining upgrades to the network.

5. Web Developer

A popular career choice among MCA graduates is getting into web designing and development. Web designers and developers enable back-end functionality and also ensure that the front end looks appealing.

6. Digital Marketing

After MCA, learners can also make a career in digital marketing. This field is emerging day by day.

7. Self-Engagement

After MCA, learners can become an entrepreneur.

8. Govt. organizations

A popular career choice among MCA graduates is getting into Govt. organizations

9. Database Engineer

As a database administrator or engineer, you would be tasked with creating and managing databases, which store and organize data. Besides building new databases, you would also configure existing systems and ensure that everything remains functional

10. Option for Higher Studies

After MCA it is highly recommended that the learner should go for higher studies, depending upon his background and interest. After MCA the learner can opt followed degrees:

- M. Tech years course
- Ph.D. Research course

3. Program Educational Objectives (PEOs)

PEO 1

- To develop the ability to excel in a professional career and/or higher education excellence through the knowledge acquisition of computing, mathematics, and information communication technology.

PEO 2

- To extend the capability to plan, analyze, design, code, test, enforce and hold the software program product.

PEO 3

- To excel in professionalism, moral attitude, conversation skills, team building, and adapting the latest ICT tools/techniques.

PEO 4

- To analyze real-world problems, design, and develop computing models/systems for multidisciplinary domains that are feasible, suitable, economical, and socially acceptable.

PEO 5

- To develop the capabilities to pursue higher studies and establish a research practice for the contribution to academia/industry and multidisciplinary research.

PEO 6

- To enhance the capabilities to initiate startups and become entrepreneurs in various domains of computer science and Information technology.

4. Programme Outcomes (POs)

Students enrolled in the Master Programmes offered by the Departments under the School of Basic Sciences will have the opportunity to learn and master the following components in addition to attaining important essential skills and abilities:

Sr. No.	Component	Outcomes
PO-1	Computational Knowledge:	Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
PO-2	Problem Analysis:	Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
PO-3	Design /Development of Solutions	Design and evaluate solutions for *complex* computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PO-4	Conduct Investigations of Complex Computing Problems	Use research-based knowledge and research methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
PO-5	Modern Tool Usage:	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to *complex* computing activities, with an understanding of the limitations.

PO-6	Professional Ethics	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.
PO-7	Life-long Learning	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO-8	Project management and finance	Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO-9	Communication Efficacy	Communicate effectively with the computing community, and with society at large, about *complex* computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
PO-10	Societal and Environmental Concerns	Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.
PO-11	Individual and Team Work	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
PO-12	Innovation and Entrepreneurship	Identify a timely opportunity and use innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

5. Programme Specific Outcomes (PSOs)

The postgraduates shall be able to realize the following outcomes by the end of program studies:

Number	Programme Specific Outcomes
PSO-1	The ability to remember and understand the basic concept of associated subjects and Computer Fundamentals, Computer Programming, Design, and Analyze different Network Techniques.
PSO-2	The proficiency to understand, evaluate and analyse the design and algorithm concepts of computer architecture, Operating systems, Computer Networks, Software Engineering, Designg and Analysis of Algorithms, Compiler Design, Artificial Intelligence, etc
PSO-3	The ability to design and solve problems in the field of Interdisciplinary subjects by applying the knowledge acquired from Data analysis, Software development & other allied topics.
PSO-4	The skills to develop, adopt, and assess the latest innovative industry best practices, then analyze and comprehend the young mindsets accordingly to their attitude toward higher studies, research, and to possess a successful path as a young entrepreneur.
PSO- 5	Analyze their abilities in systematic planning, developing, testing, and executing complex computing applications, in the field of Social Media and Analytics, Web Application Development, and Data Interpretations.

6. Postgraduate Attributes

On completion of the post-graduate programme in MCA, students are expected to equip with the skills of creative, critical, and rational thinking associated with computers and their use for human society. The following attributes are expected from the students of MCA:

Sr. No.	P.G. Attributes
PGA-1	Describe the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem-solving that involves Discrete Mathematical Structures, Design and Analysis of Algorithms, image processing, Compiler Design, etc.
PGA-2	Ability to use the updated tools, techniques, and modern Software tools necessary for software Development like Android Application Development, Data Science with R programming, Bioinformatics, Cloud Computing, etc.
PGA-3	Introduce the basic principles, techniques, and applications of Artificial Intelligence. Emphasis will be placed on the teaching of these fundamentals and labs for the hands-on approach to understanding, as well as a challenging avenue for exploration and creativity.
PGA-4	Provide professional knowledge in specialized areas such as Computer Vision, Internet of Things, Natural Language Processing, Speech Recognition, etc.
PGA-5	Communicate effectively by comprehending, documenting, making effective presentations, and exchanging clear instructions through project reports and presentations.
PGA-6	Describe the fundamental concepts, solve problems, use algorithms in machine learning and popular machine learning algorithms with programming in Python/MATLAB. And describe the concept of Deep Learning.

PGA-7	Design and implement smart, intelligent, and user-friendly interfaces for computer web applications using PHP version 5. Students will learn how to connect to any ODBC-compliant database and perform hands-on practice with a MySQL database to create database-driven HTML forms and reports, etc. Students also learn how to configure PHP and Apache Web Server.
PGA-8	Develop programming skills through C, PHP, object-oriented programming, Java Programming, Advance Java Programming & Android, etc.

PGA-9	Develop robust, efficient software systems, analyse the security requirements, examine software problems in multiple aspects including, testing and implementation that would involve software engineering, data structures, networked programming**,** Wireless Sensor Networks, Network Security, etc.
PGA-10	Analyze the relationship between organizations, information systems, business processes, Identify different techniques, store, manipulate the huge data from different resources, involving E-commerce and Data Science with R programming.

7. Mapping to SDGs

The **Sustainable Development Goals (SDGs)**, adopted by the United Nations in 2015 as part of the **2030 Agenda for Sustainable Development**, consist of **17 global goals** designed to end poverty, protect the planet, and ensure peace and prosperity for all. Education plays a central role across many of these goals, and is specifically highlighted in **SDG 4**.

Key Targets of SDG 4 include:

- Universal primary and secondary education
- Early childhood development and pre-primary education
- Equal access to affordable technical, vocational, and higher education
- Elimination of gender disparities
- Promotion of education for sustainable development and global citizenship
- Improving literacy and numeracy
- Building and upgrading education facilities that are child-, disability-, and gender-sensitive

List of SDGs

SDG1: No Poverty- *End poverty in all its forms everywhere.*

SDG2: Zero Hunger- *End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.*

SDG3: Good Health and Well-being- *Ensure healthy lives and promote well-being for all at all ages.*

SDG4: Quality Education- *Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.*

SDG5: Gender Equality- *Achieve gender equality and empower all women and girls.*

SDG6: Clean Water and Sanitation- *Ensure availability and sustainable management of water and sanitation for all.*

SDG7: Affordable and Clean Energy- *Ensure access to affordable, reliable, sustainable and modern energy for all.*

SDG8: Decent Work and Economic Growth- *Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.*

SDG9: Industry, Innovation and Infrastructure- *Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.*

SDG10: Reduced Inequality- *Reduce inequality within and among countries.*

SDG11: Sustainable Cities and Communities -*Make cities and human settlements inclusive, safe, resilient, and sustainable.*

SDG12: Responsible Consumption and Production -*Ensure sustainable consumption and production patterns.*

SDG13: Climate Action- *Take urgent action to combat climate change and its impacts.*

SDG14: Life Below Water- *Conserve and sustainably use the oceans, seas, and marine resources.*

SDG15: Life on Land- *Protect, restore and promote sustainable use of terrestrial ecosystems, manage forests sustainably, combat desertification, and halt biodiversity loss.*

SDG16: Peace, Justice and Strong Institutions - *Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable institutions.*

SDG17: Partnerships for the Goals - *Strengthen the means of implementation and revitalize the global partnership for sustainable development.*

Table: Mapping of SDG to Courses

Sr. No.	Course Title	SDGs Mapped	Rationale
1.	Computer Fundamentals & C Programming	4, 8, 9	Laying the Foundation for Lifelong Learning, Promoting Digital Literacy
2.	Data Structures	4	Enhances Computational Thinking, Builds Employable Technical Skills
3.	Discrete Mathematics	4, 13, 16	Develops Analytical Thinking, Supports Career & Academic Growth
4.	Operating Systems	4, 9	Enables innovation in embedded systems, IoT, AI systems, and cloud infrastructure
5.	Artificial Intelligence	4, 8, 9	Equips learners with cutting-edge skills in machine learning, data science, robotics, and automation
6.	Data Structures Lab	4, 8	Skill development, Boosts productivity
7.	Artificial Intelligence Lab using Python	4, 8, 9	Promotes problem-solving and innovation, Enhance scientific research, upgrade the technological capabilities of industrial sectors, Promotes entrepreneurship through AI-driven product development

8.	Database Management Systems	4, 8, 9, 16	Prepares students for careers in data-driven roles such as data analyst, database administrator, and backend developer.
9.	Computer Networks	4, 5, 8, 9	Enables efficient digital communication across businesses and governments, boosting productivity and service delivery.
10.	Design and Analysis of Algorithms	4, 8, 9	Enhances core analytical and programming skills, Supports innovation and efficient system design, Prepares students for competitive technical roles and research.
11.	Database Management Systems Lab	4, 5, 8, 9	Offers hands-on, technical skill development, Prepares students for roles in data-driven industries, Supports digital infrastructure and innovation through database expertise
12.	Design and Analysis of Algorithms Lab	4, 8, 9, 12	Builds hands-on algorithmic skills for complex problem-solving, Prepares students for technical and R&D careers, Contributes to innovation, productivity, and optimized infrastructure
13.	Machine Learning Techniques	3, 4, 8, 9	Enables smart health solutions, Builds cutting-edge skills in data science and AI, Supports innovation across sectors, Increases career readiness and economic opportunities
14.	Foundations of Data Science	3, 4, 8, 9, 11	Enables data-driven healthcare, urban sustainability, and governance, Teaches essential digital and analytical skills, Opens doors to high-value employment and entrepreneurship, Supports innovation and research-driven development
15.	Data Warehousing and Data Mining	3, 4, 8, 9	Enhances employability in data-intensive industries, Builds core skills in managing and analyzing large-scale data, Supports research, healthcare analytics, and smart city planning, Powers innovation through data-driven insights
16.	Network Security	4, 8, 9, 16	Builds essential skills in cybersecurity and digital protection, Promotes jobs and economic stability in the tech sector, Enables innovation through protected infrastructure, Supports secure, trustworthy institutions and governance
17.	Cryptography	4, 8, 9, 16	Builds strong educational foundation in security and mathematics, Enables growth of secure digital economies and job markets, Supports robust digital infrastructure and innovation,

			Ensures privacy, data protection, and secure access to information
18.	Information Systems Security	4, 5, 8, 9	Equips learners with in-demand cybersecurity skills, Drives secure digital growth and high-value employment, Builds resilient and secure digital infrastructures, Strengthens digital governance, public trust, and national security.
19.	Computer Graphics	4, 8, 9, 11, 17	Builds skills in visualization, modeling, and creativity, Supports high-skill employment and creative entrepreneurship, Drives innovation in design, simulation, and entertainment industries, Aids urban planning and digital sustainability efforts.
20.	Digital Image Processing	3, 11	Supports innovations in medical diagnosis and healthcare delivery, Boosts employability in AI, robotics, media, and remote sensing
21.	Information Retrieval	4, 8, 9, 16	Trains students in intelligent search and retrieval systems, Drives innovation in AI, tech industries, and digital transformation, Enables open access to legal, scientific, and institutional data, Supports educational tools and access to digital knowledge
22.	Advanced Computer Architecture	13	Encourages sustainable and energy-efficient hardware development
23.	Cloud Computing	13, 17	Supports sustainable computing through efficient infrastructure, Facilitates global cooperation and knowledge sharing through cloud-hosted platforms
24.	Quantum Computing	3, 13, 17	Supports healthcare breakthroughs through molecular modeling, Holds potential to tackle climate and sustainability challenges, Encourages international collaboration in cutting-edge science
25.	Web Development	8, 17	Decent Work & Economic Growth, Partnerships for the Goals
26.	Android Applications Development	3, 17	Android apps support collaborative tools, data sharing platforms, and community networks.
27.	Cloud & DevOps	9, 17	core enablers of digital, sustainable, and collaborative growth
28.	Object Oriented Programming	4, 8, 9	Builds core digital skills in programming and software development, Enables structured, scalable, and real-world software solutions, Contributes to economic growth through job creation and innovation

29.	Theoretical Computer Science	4, 9, 17	Builds strong educational foundations in computing theory, Supports innovation through rigorous problem modeling and algorithm design, Encourages international research partnerships and knowledge sharing
30.	Software Engineering	4, 8, 9, 17	Develops critical skills for the digital workforce, Enables innovation and modern digital services, Drives entrepreneurship and job creation, Promotes global collaboration and tech-enabled SDG solutions
31.	Object Oriented Programming Lab	4, 8, 9	Provides practical, employable programming skills, Builds industry-aligned experience in software design, Encourages development of digital infrastructure and innovation
32.	Minor Project	4, 8, 9, 17	Applies technical knowledge in meaningful and practical ways, Builds innovation, problem-solving, and employability, Encourages collaborative, research-driven solutions aligned with real-world needs, Potential to address or support specific SDGs depending on project themes.
33.	Summer Training/Internship	4, 8, 9, 17	Enhances job-readiness and real-world skills, Promotes technical innovation and workplace productivity, Builds bridges between academia and industry, Empowers youth to contribute to a sustainable economy
34.	Deep Learning Techniques	3, 4, 8, 9, 17	Builds AI capabilities and innovation mindset in learners, Powers digital transformation and smart infrastructure, Drives economic opportunities through new AI-based industries, Supports critical SDG domains like health, education, and climate, Promotes global collaboration on data-driven solutions
35.	Time Series Analysis and Forecasting	4, 8, 9, 13	Powers predictive systems in health, climate, economy, and industry; Strengthens resilience and planning through data trends and forecasting; Builds modern analytical and technical competencies in students; Drives innovation and sustainable practices in multiple domains
36.	Ethical Hacking	4, 8, 16, 17	Builds secure and trustworthy digital systems; Trains students in critical cybersecurity skills; Supports global digital cooperation and resilience; Enhances employability and career readiness in a crucial tech domain

37.	Blockchain Technology and Applications	4, 9, 16, 17	Enables trust, transparency, and accountability in digital systems; Powers cross-sector innovation through decentralization; Enhances career readiness and modern tech skills; Supports secure and inclusive digital economies
38.	Natural Language Processing	3, 4, 8, 9, 16, 17	Enhances access to information across languages and regions; Promotes inclusive, equitable, and multilingual digital systems; Supports automation and innovation in industry and healthcare; Builds skills and opportunities in AI-driven global job markets
39.	Computer Vision	3, 4, 9, 11, 13	Drives healthcare innovation through intelligent diagnosis; Powers industrial and infrastructure automation; Enhances urban safety, monitoring, and sustainability; Builds technical capacity and inclusive education tools; Supports climate resilience and environmental monitoring
40.	Compiler Design	4, 8, 9	Equips students with fundamental knowledge for system-level programming; Enhances innovation in software development and language design; Prepares students for careers in core computing and R&D roles
41.	GPU Computing	3, 4, 8, 9, 13	Drives AI, scientific research, and sustainable innovation; Enhances education and builds in-demand technical skills; Supports healthcare and climate action with high-speed data processing
42.	Build and Release Management	4, 8, 9, 12	Promotes automation and efficient software delivery; Builds skills for high-demand DevOps careers; Supports sustainable development and resource efficiency; Strengthens innovation and digital infrastructure
43.	Robotic Process Automation & Development	4, 12	Enhances business efficiency and resource utilization; Supports sustainable digital transformation
44.	Project Work	4, 8, 9, 17	Encourages hands-on learning and innovation; Prepares students for industry and research careers; Builds teamwork, creativity, and responsibility; Can directly address real-world SDG challenges

8. Structure of Master of Computer Applications (MCA)

General, Course structure, Theme & Semester-wise Credit Distribution

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
2 Hours Practical (Lab)/week	1 credit

B. Total credits:

The total credits of the MCA 2 Year programme are 91. The minimum qualifying marks for each course of the programme shall be 40%.

C. Structure of MCA Program:

Sr. No.	Category	Breakup of Credits	%
1	**Professional Core Courses**	**45**	**49.45**
2	**Program Elective Courses**	**12**	**13.18**
3	**General Elective Courses**: (Taken from other departments)	**8**	**8.79**
4	**Project work** and Internship in Industry / in house	**4+2+20=26**	**28.57**
5	**Bridge Course:** [Computer Fundamentals and C Programming]	**Non- Credit**	
	Total	**91**	

9. Learning Outcome Index

(Mapping of Courses with POs and PSOs)

A) Mapping of Courses with POs (First Year)

Semester	POs ⇨ / Courses ⇩	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
I	CC-1	✓	✓	×	✓	×	✓	✓	×	✓	✓	×	×
	CC-2	✓	✓	✓	×	✓	✓	✓	×	✓	×	✓	×
	CC-3	✓	✓	✓	✓	×	×	✓	×	✓	×	×	×
	CC-4	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	×	✓
	CCP-1	×	✓	✓	✓	×	✓	✓	×	✓	×	✓	✓
	CCP-2	✓	×	✓	×	✓	×	✓	✓	✓	✓	✓	×
	MDC-1	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	×
	BC- 1	✓	×	✓	×	✓	✓	✓	✓	✓	×	✓	×
II	CC-1	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓
	CC-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	CC-3	✓	✓	×	✓	✓	×	✓	✓	✓	✓	✓	✓
	CCP-1	✓	✓	✓	✓	✓	×	✓	×	✓	✓	×	✓
	CCP-2	×	✓	✓	✓	✓	✓	✓	×	✓	×	✓	✓
	MP	✓	×	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
	DSE-1	✓	×	✓	✓	✓	✓	✓	×	✓	×	×	×
	DSE-2	✓	✓	×	×	✓	×	✓	×	✓	✓	×	×

B) Mapping of Courses with POs (Second Year)

Semester	POs ⇨	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12

	Courses ⇩												
III	CC-1	✓	×	×	✓	✓	✓	✓	×	✓	✓	✓	✓
	CC-2	✓	✓	✓	✓	✓	✓	×	✓	✓	×	✓	×
	CC-3	✓	✓	×	✓	✓	×	✓	×	✓	✓	×	✓
	CCP-1	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
	DSE-3	×	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
	MDC-2	✓	✓	×	✓	✓	✓	×	×	✓	✓	×	✓
	MP	✓	×	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
	STR	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
IV	CC-1	✓	✓	×	✓	✓	✓	×	✓	✓	✓	✓	✓

B) Mapping of Courses with PSOs (First Year)

Semester	POs ⇨	PSO-1	PSO-2	PSO-3	PSO-4	PSO5
	Courses ⇩					
I	CC-1	✓	✓	×	✓	×
	CC-2	✓	✓	×	×	✓
	CC-3	×	✓	×	✓	×
	CC-4	✓	✓	×	✓	✓
	CCP-1	✓	✓	✓	✓	×
	CCP-2	✓	×	×	×	✓
	MDC-1	×	✓	✓	×	✓
	BC- 1	✓	✓	✓	×	✓
II	CC-1	✓	✓	×	✓	×
	CC-2	✓	✓	✓	×	✓
	CC-3	×	✓	✓	✓	×
	CCP-1	✓	✓	×	✓	✓

	CCP-2	✓	✓	✓	✓	✗
	DSE-1	✓	✗	✗	✗	✓
	DSE-2	✓	✗	✗	✗	✓
	MP	✓	✓	✓	✓	✓

B) Mapping of Courses with PSOs (Second Year)

Semester	**POs ⇨**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
	Courses ⇩					
III	**CC-1**	✓	✓	✗	✓	✗
	CC-2	✓	✓	✓	✗	✓
	CC-3	✓	✓	✗	✓	✗
	DSE-3	✗	✓	✓	✓	✓
	CCP-1	✓	✓	✓	✓	✗
	MDC-2	✓	✗	✗	✗	✓
	MP	✓	✓	✓	✓	✓
	STR	✓	✓	✓	✓	✓
IV	**CC-1**	✓	✓	✗	✓	✗

10. Semester-wise Courses and Credit Distribution

Scheme for MCA

<table>
<tr><td rowspan="2">I
(400)</td><td>I</td><td>Data Structures</td><td>Discrete Mathematics</td><td>Operating Systems</td><td>AI</td><td>MDC-1</td><td>Artificial Intelligence Lab using Python LTPC:0021</td><td>Data Structures Lab LTPC 0021</td><td>22</td><td rowspan="2">44 + 4*</td><td rowspan="2">Exit: PG-Dip NHEQF: 6</td><td rowspan="4">2-yr MSc NHEQF:6.5</td></tr>
<tr><td>II</td><td>DBMS</td><td>Computer Networks</td><td>Design and Analysis of Algorithms</td><td>DSE-1 LTPC 3024</td><td>DSE-2 LTPC 3024</td><td>DBMS Lab LTPC 0021</td><td>DAA Lab LTPC 0021</td><td>22 +4 *</td></tr>
<tr><td colspan="10">Minor Project # (4 credits)</td></tr>
<tr><td rowspan="3">II
(500)</td><td>III</td><td>Object Oriented Programming</td><td>Theoretical Computer Science</td><td>Software Engineering</td><td>DSE-3 LTPC 3024</td><td>MDC-2</td><td>Object Oriented Programming Lab LTPC 0021</td><td>Minor Project</td><td>Summer Training</td><td>27</td><td rowspan="3">47</td><td rowspan="3">1-yr MSc NHEQF: 6.5</td></tr>
<tr><td>IV</td><td>DSC-1 LTPC: 3024</td><td>DSC-2 LTPC: 3024</td><td>DSC-3 LTPC: 3024</td><td colspan="2">DSC-4 LTPC: 3024</td><td colspan="3">DSC-5 LTPC: 3024</td><td>20</td></tr>
<tr><td colspan="10">Major Project (20)</td></tr>
<tr><td colspan="11">Year-long Project Work (47)</td></tr>
</table>

1. *DSE course offering would depend upon the resources.*
2. *Alternatively, department may approve suitable courses from SWAYAM.*
3. ***Criterion for Semester-long Major Project**: at least 7.0 CGPA, with no back-log.*
4. ***Criterion for Year-long Major Project**: at least 7.5 CGPA, with no back-log.*
5. ***Request for Major Project has to be submitted to the HOD for approval well before its start**.*

Total Credit = 91

Semester Wise Distribution of Credits: 22 + 22 + 27 + 20

Eligibility for Admission to MCA:

Passed B.C.A/ B.Sc. (Computer Science)/ B.Sc. (IT) / B.E. (CSE)/ B.Tech. (CSE) / B.E. (IT) / B.Tech. (IT) or equivalent Degree.

OR

Passed any graduation degree (e.g.: B.E. / B.Tech. / B. Sc / B.Com. / B.A./ B. Voc./ etc.,) with Mathematics at 10+2 level or at Graduation level Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying examination. (*The students admitted with this eligibility will have to simultaneously undertake additional Bridge Course(s) as prescribed by the University during the first year*).

Bridge Course (Non-Credit Course)								
Sr. No.	**Course Code and Course No**	**Course Title**	**L**	**T**	**P**	**Hrs/Week**	**Total Credits**	**NEP-2020 relevancy**
1	CST401BC00	Computer Fundamentals and C Programming	**3**	**0**	**2**	**4**	**0**	Basic Programming Skills development

Note: It is mandatory for all students from **non-computer backgrounds** to pass out Bridge Course within the first year. Bridge Course will be offered only in the first semester and is common to students enrolled in MCA and M.SC. (Data Science) programmes.

Semester -1

Sr. No.	Course Code	Course Title	L	T	P	Hrs/Week	Total Credits	NEP-202 Relevancy
1	CST403DM40	Data Structures	3	1	0	4	4	Complex Data Structure skills
2	CST405DM40	Discrete Mathematics	3	1	0	4	4	Mathematical Reasoning Skills
3	CST407DM40	Operating Systems	3	1	0	4	4	Operating Systems Skills
4	CST409DM40	Artificial Intelligence	3	1	0	4	4	Artificial Intelligence Skills
5	MDC-I						4	
6	CST411DM10	Data Structures Lab	0	0	2	2	1	Data Structure Skills Development
7	CST413DM10	Artificial Intelligence Lab using Python	0	0	2	2	1	Python Programming Skills Development
		Total Credits					**22**	

Semester – II

Sr. No.	Course Code	Course Title	L	T	P	Hrs/Week	Total Credits	Level
1	CST402DM40	Database Management Systems	**3**	**1**	**0**	**4**	**4**	Database Manipulation Skills
2	CST404DM40	Computer Networks	**3**	**1**	**0**	**4**	**4**	Computer Networks Skills
3	CST406DM40	Design and Analysis of Algorithms	**3**	**1**	**0**	**4**	**4**	Algorithmic Skills
4	DSE-1		**3**	**0**	**2**	5	**4**	
5	DSE-2		**3**	**0**	**2**	5	**4**	
6	CST408DM10	Database Management Systems Lab	**0**	**0**	**2**	**2**	**1**	Database Manipulation Skills Implementation
7	CST412DM10	Design and Analysis of Algorithms Lab	**0**	**0**	**2**	**2**	**1**	Algorithmic Design Skills
8	CST414DM40	Minor Project *					**4**	Project Development Skills
Total Credits							**22 (22 + 4* = 26)**	

* Applicable to those students who opt to exit after first year. For minor project, there will be two presentations:

- **Mid-term Presentation**: Carries 40% weightage
- **End-semester Presentation**: Carries 60% weightage

Note: Students have to undergo the training during summer vacations and prepare its report which will be evaluated in the 3rd Semester.

Semester – III

Sr. No.	Course Code	Course Title	L	T	P	Hrs/ Week	Total Credits	Level
1	CST501DM40	Object Oriented Programming	**3**	**1**	**0**	**4**	**4**	OOPs Skills Development
2	CST503DM40	Theoretical Computer Science	**3**	**1**	**0**	**4**	**4**	Computational Solving Skills
3	CST505DM40	Software Engineering	**3**	**1**	**0**	**4**	**4**	Software Engineering Skills
4	DSE-3		**3**	**0**	**2**	**5**	**4**	
5	MDC-2						**4**	
6	CST507DM10	Object Oriented Programming Lab	**0**	**0**	**2**	**2**	**1**	Java Programming Skills
7	CST414DM40	Minor Project*					**4**	Project Development Skills
8	CST509DM20	Summer Training/Internship					**2**	Real Time Application Development
Total Credits							**27**	

*There will be two presentations for Minor Project:

- **Mid-term Presentation**: Carries 40% weightage
- **End-Semester Presentation**: Carries 60% weightage

Semester – IV
Project Semester

Sr. No.	Course Code	Course Title	L	T	P	Hrs/ Week	Total Credits	NEP Relevancy
1	CST502SRP20	Project Work	-	-	-	-	20	Project Development Skills
OR								
2	CST504DM40	DSC 1	3	0	2	5	4	
3	CST506DM40	DSC 2	3	0	2	5	4	
4	CST508DM40	DSC 3	3	0	2	5	4	
5	CST512DM40	DSC 4	3	0	2	5	4	
6	CST514DM40	DSC 5	3	0	2	5	4	
Total Credits							**20**	

This semester is designated for an internship to be undertaken in an industry or organization, focusing on an industrial or research-based project. The total marks allocated for this project work are 500. Each student will be assigned a faculty member from the department as a mentor and will also be guided by an external or industry mentor. The progress of the internship will be jointly monitored by both mentors.

DSC- Discipline Specific Course

There will be two presentations for the Project Work:

- **Mid-term Presentation**: Carries 40% weightage
- **End-semester Presentation**: Carries 60% weightage

List for Discipline Specific Electives- I and II

Data Science and AI								
1	CST416DS40	Machine Learning Techniques	**3**	**0**	**2**	5	**4**	Machine Learning Skills
2	CST418DS40	Foundations of Data Science	**3**	**0**	**2**	5	**4**	Data Science Skills
3	CST422DS40	Data Warehousing and Data Mining	**3**	**0**	**2**	5	**4**	Data Mining Skills
Information and Cyber Security								
4	CST424DS40	Network Security	**3**	**0**	**2**	5	**4**	Network Security Skills development
5	CST426DS40	Cryptography	**3**	**0**	**2**	5	**4**	Cryptography Skills development
6	CST428DS40	Information Systems Security	**3**	**0**	**2**	5	**4**	Information Systems Security Skills development
Multimedia Techniques								
7	CST432DS40	Computer Graphics	**3**	**0**	**2**	5	**4**	Graphis skills development
8	CST434DS40	Digital Image Processing	**3**	**0**	**2**	5	**4**	Image Processing Skills development
9	CST436DS40	Information Retrieval	**3**	**0**	**2**	5	**4**	Information Retrieval Skills development
Advanced Computing								
10	CST438DS40	Advanced Computer Architecture	**3**	**0**	**2**	5	**4**	Computer Architecture skills
11	CST442DS40	Cloud Computing	**3**	**0**	**2**	5	**4**	Cloud Computing Skills

12	CST444DS40	Quantum Computing	**3**	**0**	**2**	5	**4**	Quantum Computing Skills
Dev Ops and Full Stack								
13	CST448DS40	Web Development	**3**	**0**	**2**	5	**4**	Source Code management skills
14	CST452DS40	Android Applications Development	**3**	**0**	**2**	5	**4**	Web application skills development
15	CST454DS40	Cloud & DevOps	**3**	**0**	**2**	5	**4**	App development

Note: A student will have to select one basket out of the above five baskets for the electives.

List for Discipline Specific Electives -III

Data Science and AI								
1	CST511DS40	Deep Learning Techniques	**3**	**0**	**2**	5	**4**	Deep Learning Skills
2	CST513DS40	Time Series Analysis and Forecasting	**3**	**0**	**2**	5	**4**	Time Series Analysis and Forecasting Skills
Information and Cyber Security								
3	CST515DS40	Ethical Hacking	**3**	**0**	**2**	5	**4**	Ethical Hacking Skills
4	CST517DS40	Blockchain Technology and Applications	**3**	**0**	**2**	5	**4**	Blockchain Technology Development Skills
Multimedia Techniques								
5	CST519DS40	Natural Language Processing	**3**	**0**	**2**	5	**4**	Natural Language Processing Applications Development Skills
6	CST521DS40	Computer Vision	**3**	**0**	**2**	5	**4**	Computer Graphics Skills
Advanced Computing								
7	CST523DS40	Compiler Design	**3**	**0**	**2**	5	**4**	Compiler Design Skills
8	CST525DS40	GPU Computing	**3**	**0**	**2**	5	**4**	GPU based Application Development
Dev Ops and Full Stack								
9	CST527DS40	Build and Release Management	**3**	**0**	**2**	5	**4**	Build and Release Skills Development
10	CST529DS40	Robotic Process Automation & Development	**3**	**0**	**2**	5	**4**	Robotic Automation Development Skills Development

Multi-Disciplinary Courses (for students of other Departments)

Course Code	Course Name	L	T	P	Hr/Week	Credits	NEP Relevancy
CST110MD40	Fundamentals of Computer Science	**3**	**1**	**0**	**4**	**4**	**Computer Fundamentals skills development**
CST120MD40	C Programming	**3**	**0**	**2**	**5**	**4**	**Programming skills Development**
CST130MD40	Python Programming	**3**	**0**	**2**	**5**	**4**	**Python Programming skills**
CST140MD40	R Programming	**3**	**0**	**2**	**5**	**4**	**Data Analysis skills**
CST150MD40	Internet Fundamentals	**3**	**1**	**0**	**4**	**4**	**Internet skills development**
CST160MD40	Management Information System and E-Commerce	**3**	**1**	**0**	**4**	**4**	**Managing Markets over online platform**

11. Course-Level Learning Outcomes

Bridge Course

<table>
<tr><td>Scheme Version: 2025-Onwards</td><td colspan="5">Course Name:
Computer Fundamentals and C Programming</td><td>Course Code:
CST401BC00</td></tr>
<tr><td>Programme:
MCA/M. Sc.</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: I</td><td>3</td><td>0</td><td>2</td><td>0</td><td>Total Hours: 48(L)+32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to provide foundational knowledge of computer systems, including hardware, software, and input/output devices. It introduces students to C programming concepts such as data types, control structures, functions, and basic data structures, enabling them to write efficient and structured code.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1: Understand the evolution, classification, and components of computer systems along with their key characteristics.
CO2: Explain the working of various input, output, and storage devices used in computer systems.
CO3: Develop basic programs in C using data types, operators, control statements, and structured logic.
CO4: Implement functions, data structures, and pointer operations in C to solve programming problems effectively.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Outcome(s) No: 1]** **Overview of Computer System:** Evolution of Computer Systems, Generations of Computers, Parts of Computer System, Categories of Computers, Computer System Characteristics, Computer Hardware. Working of input & output devices: keyboard, mouse, trackball, pen, touch screens, scanner, digital camera, monitor, and printer. Working of storage devices: magnetic tape, magnetic disk, CD, DVD. Software- System & Application.	12
2	**[Course Outcome(s) No: 2]** **Elements of C:** Character set identifier and keywords, data type, declaration and definition. Operators: arithmetic, relational, logical, bit wise, unary, assignment and conditional operators their hierarchy arid associativity. Control statements: sequencing, selection, if and switch statement; repetition / loop statements: for, while, and do while loops; break, continue and goto statements.	11
3	**[Course Outcome(s) No: 3]** **Function:** Definition, declaration, and calling, call by value, call by reference prototype, passing parameters, actual and formal parameters, recursion.	12
4	**[Course Outcome(s) No: 4]** **Data Structures:** Arrays, structure, structure members, access to structure members union, string, data files. Pointer: declaration, operation of pointers, array to pointers, pointers to arrays.	13

Suggested Readings:

1. Norton, P., *Introduction to Computers*, Mc-Graw-Hill, 6th Ed. 2020.
2. Raja, Raman V., *Fundamental of Computers*, Prentice Hall of India,6th Ed., 2019.
3. Sanders, D. H., *Computer Today*, Mc-Graw Hill, 6th Ed., 2018.
4. Sinha, P.K. and Sinha, P., *Computer fundamentals*, BPB Publications, 8th Ed., 2020.

Semester I

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="5">Course Name:

Data Structures</td><td colspan="2">Course Code:

CST403DM40</td></tr>
<tr><td>Programme:

MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>Semester: 1</td><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+16(T) = 64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to provide a strong foundation in data structures and algorithms, focusing on linear and non-linear structures such as arrays, stacks, queues, linked lists, trees, and graphs. It also emphasizes the implementation and analysis of searching, sorting, and hashing techniques to develop efficient problem-solving skills.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1: Understand fundamental data structures, algorithms, and their time-space complexity trade-offs.
CO2: Implement and analyze linear data structures such as arrays, stacks, queues, and linked lists.
CO3: Apply non-linear data structures like trees and graphs for hierarchical and networked data representation.
CO4: Use appropriate searching, sorting, and hashing techniques to enhance data access and manipulation efficiency.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Total Hours
1	**[Course Outcome(s) No: 1]** **Introduction-** Basic Terminology, Elementary Data Organization, Structure Operations, Algorithm, Complexity and Time- Space trade-off. **Arrays:** Array Definition, Representation and Analysis, Single and Multidimensional Arrays, Address Calculation, Application of Arrays.	**10**
2	**[Course Outcome(s) No: 2]** **Stacks-** Array Representation and Implementation of the stack, Operations on Stacks: Push & Pop, Array Representation of Stack, Linked Representation of Stack, Operations Associated with Stacks, Application of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. **Queues:** Array and linked representation of a queue, Implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, D-queues and Priority Queues. **Linked list:** Representation and Implementation of Singly Linked Lists, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, Doubly Linked List, Linked List in Array.	**15**
3	**[Course Outcome(s) No: 3]** **Trees:** Basic terminology, Binary Trees, Binary tree representation, Array and Linked Representation of Binary trees, Types of Binary Tree, Traversing Binary trees, Binary Search Tree (BST), Insertion and Deletion in BST, AVL Trees, Huffman algorithm. **Graphs:** Terminology & Representations, Graphs & Multi-graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Graph traversal: BFS, DFS.	**11**
4	**[Course Outcome(s) No: 4]** **Searching and Hashing:** Sequential search, binary search, comparison and analysis, Hash Table, Hash Functions, Collision Resolution	**12**

	Strategies, Hash Table Implementation. **Sorting:** Insertion Sort, Bubble Sorting, Selection Sort, Quick Sort, Merge Sort, Heap Sort, Linear time sorting, Practical consideration for Internal Sorting and External Sorting.	

Suggested Readings:

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., *Introduction to Algorithms,* MIT Press, 4th Ed. 2022.
2. Goodrich, M.T., Tamassia, R. and Mount, D.M., *Data Structures and Algorithms in C++*, John Wiley & Sons, 6th Ed. 2016.
3. Langsam, Y., Augenstein, M. and Tenenbaum, A.M., *Data Structures using C and C++,* Prentice Hall, 2nd Ed. 2015.
4. Lipschutz, S., *Schaum's Outline of Theory and Problems of Data Structures*, McGraw-Hill, 3rd Ed. 2017.

<table>
<tr><td>Scheme
Version:
2025-Onwards</td><td colspan="4">Course Name:
Discrete Mathematics</td><td colspan="2">Course Code:
CST405DM40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>Semester: 1</td><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours:
48(L)+16(T) = 64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to develop a strong foundation in discrete mathematics by introducing core concepts such as set theory, relations, algebraic structures, and propositional logic. It also focuses on graph theory and trees to build logical reasoning and problem-solving skills essential for computer science applications.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1: Apply the principles of set theory and counting to solve problems involving Venn diagrams, Cartesian products, and countability.
CO2: Analyze and classify different types of relations, their properties, and visualize them using Hasse diagrams and lattices.
CO3: Understand and apply algebraic structures such as groups, rings, and fields in computational contexts.
CO4: Construct and evaluate logical expressions using propositional and predicate logic, truth tables, and Karnaugh maps.
CO5: Analyze and solve problems involving graphs and trees, including traversal, coloring, and pathfinding algorithms.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Outcome(s) No: 1]** **Set Theory:** Definition of Sets, Venn Diagrams, complements, Cartesian products, power sets, counting principle, cardinality and count ability (Countable and Uncountable sets), proofs of some general identities on sets, pigeonhole principle. **Relation:** Definition, Types of relation, the composition of relations, domain and range of a relation, pictorial representation of a relation, properties of relation, partial ordering relation, Lattices, Hasse diagram.	**12**
2	**[Course Outcome(s) No: 2]** **Algebraic Structure:** Binary composition and its properties definition of algebraic structure. **Groups:** Semi-group, Monoid Groups, Abelian group, properties of groups, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields (definition and standard results).	**14**
3	**[Course Outcome(s) No: 3]** **Propositional Logic:** Proposition logic, Basic logic, Togical connectives, truth tables, Tautologies, contradiction, normal forms (conjunctive and disjunctive), modus Ponens and modus Tollens, validity, predicate logic, universal and existential quantification, Boolean expressions, Karnaugh map.	**12**
4	**[Course Outcome(s) No: 4 & 5]** **Graphs:** Graph Terminology, Types of graphs, Connected Graphs, Components of the graph, Euler Graph, Hamiltonian Path and Circuits, Graph coloring, Chromatic number. **Tree:** Definition, Types of trees, Properties of trees, Spanning trees, minimum spanning trees (Prim's and Kruskal's algorithms).	**10**

Suggested Readings:

1. Lipschutz, S., and Lipson, M.L., *Discrete Mathematics*, McGraw-Hill, 4th Ed. 2021.
2. Liu, C.L., and Mohapatra, D.P., *Elements of Discrete Mathematics: A Computer Oriented Approach,* Tata McGraw-Hill, 2019.
3. Rosen, K.H., and Krithivasan, K., *Discrete Mathematics and Its Applications: With Combinatorics and Graph Theory*, Tata McGraw-Hill Education, 8th Ed. 2021.
4. Sarkar, S.K., *A Textbook of Discrete Mathematics*, S. Chand Publishing, 9th Ed. 2019.

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="5">Course Name:
Operating Systems</td><td colspan="2">Course Code:
CST407DM40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>Semester: I</td><td>3</td><td>1</td><td>0</td><td>4</td><td>Total Hours:
48(L)+16(T) = 64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">A successful student will be able to understand the basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Demonstrates the basic concepts of key Linux library functions and system calls.
CO2 Understand the inner workings of Linux operating systems.
CO3 Apply shell scripts to perform repetitive tasks using while and for loops.
CO4 Design analysis and implementation of shell functions.
CO5 Result evaluation using deadlock and shell programming.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:

Maximum Marks = 70 Time: 3 Hours

Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Operating System Introduction:** function, characteristics, structures– simple batch, multiprogram med, Time shared, personal computer, parallel, distributed systems, real-time systems, system components, operating system services, system calls, virtual machines. **Process and CPU Scheduling:** Process concepts and scheduling, operation on processes, cooperating processes, threads, and inter-process communication scheduling criteria, scheduling algorithm, multiple-processor scheduling, real-time scheduling.	12
2	**[Course Objective(s) No.: 2]** **Management and Virtual memory:** logical versus physical address space, swapping, contiguous allocation, paging, segmentation, segmentation with paging. Demand paging, performance of denuding paging, page replacement, page replacement algorithm, allocation of frames, thrashing.	10
3	**[Course Objective(s) No.: 3]** **File System Interface and Implementation:** access methods, directory, structure, protection, file system structure, allocation methods, free space management, directory management, directory implementation, efficiency, and performance. **I/O Management:** I/O software and its types, disk scheduling. **Process Management and Synchronization:** Critical section problem, synchronization, critical regions, monitors.	14
4	**[Course Objective(s) No.: 4 & 5]** **Deadlocks:** System model, deadlocks characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, and recovery from deadlock. **Shell Programming:** vi editor, shell variables, I/O in shell, control structures, loops, subprograms, creating shell scripts. Basic system administration in Linux/Unix.	12

Suggested Readings:

1. Silberschatz, Galvin and Gagne, *Operating System Principles*, Addison Wesley, 9th Ed. 2013
2. Tanenbaum, *Modern Operating Systems*, PHI, 5th Ed. 2024
3. William Stalling, *Operating Systems*, Mac Millan, 6th Ed. 1995
4. H. M. Dietel, *Operating Systems*, Addison Wesley Longman, 3rd Ed. 2007

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="4">Course Name:
Artificial Intelligence</td><td colspan="2">Course Code:
CST409DM40</td></tr>
<tr><td>Programme:

MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: I</td><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course provides a comprehensive understanding of fundamental AI concepts, including problem representation, search strategies, and knowledge representation techniques. It also covers expert system architectures, methods for managing uncertainty, and explores ethical considerations alongside recent advances in AI technologies.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:

CO1: Understand the foundational principles and evolution of Artificial Intelligence and intelligent agents.

CO2: Develop problem-solving skills using classical search algorithms and adversarial strategies.

CO3: Apply logical reasoning and various knowledge representation techniques to model intelligent behavior.

CO4: Explore natural language processing fundamentals and their role in AI communication systems.

CO5: Develop an Expert system for real-world applications such as games and simulations.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.</td></tr>
</table>

3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Outcome No(s).: 1]** **Basic Concepts:** AI and its importance, Definition and History of AI, AI approach for solving problems. Rationality and types of agents, Structure of intelligent agents, PEAS (Performance, Environment, Actuators, Sensors) model, Environments: fully vs. partially observable, deterministic vs. stochastic, static vs. dynamic, discrete vs. continuous.	12
2	**[Course Outcome No(s).: 2]** **Problem formulation:** Initial state, actions, goal test, path cost, **Search strategies:** Uninformed search: BFS, DFS, Depth-Limited, Iterative Deepening, Informed search: Greedy Best-First, A, A* algorithm, mini- max *etc*. Computational complexity, Properties of search algorithms: Admissibility, Monotonicity, Optimality, Dominance, etc., **Adversarial search**: Game playing, minimax algorithm, alpha-beta pruning, Constraint Satisfaction Problems. Genetic algorithms.	12
3	**[Course Outcome No(s).: 3]** **Knowledge Representation and Reasoning:** Approaches to knowledge representation, Propositional logic: syntax, semantics, inference rules, First-order predicate logic: syntax, semantics, unification, resolution, Knowledge representation issues: granularity, completeness, consistency, Semantic networks, frames, Ontologies and description logics, Reasoning with uncertainty: Bayesian networks (concept only)	12
4	**[Course Outcome No(s).: 4 & 5]** **Expert System Architecture:** Rule-based architecture, non-production system architecture. Components of Expert Systems, Stages of expert system development, Expert systems applications, Building Expert System and Shell. Knowledge acquisition and validation.	12

Suggested Readings:

1. Stuart Russell, Peter Norvi, *Artificial intelligence: A modern approach*, Pearson,4th Ed. 2020.

2. Kevin Knight, Elaine Rich, Shivashankar B. Nair, *Artificial intelligence*, McGraw Hill Education, 3rd Ed. 2017.

3. Ertel, W. *Introduction to Artificial Intelligence*, Springer, 2nd Ed. 2018.

4. Zhongzhi Shi, *Advanced Artificial Intelligence*, World Scientific; 2019.

Semester II

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="4">Course Name:
Database Management Systems</td><td colspan="2">Course Code:
CST402DM40</td></tr>
<tr><td rowspan="2">Programme:
MCA
Semester: II</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+16(T) = 64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course is intended to provide an introduction to the management of database systems. The course emphasizes the understanding of the fundamentals of relational systems including data models, database architectures, and database manipulations. The course uses a problem-based approach to learning.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Elaborate on different issues involved in the design and implementation of the basic database system. Study the physical and logical database designs, database modelling, relational, hierarchical, and network models.
CO2 Understanding and Practice on data manipulation language to query, update and manage a database.
CO3 Determine essential DBMS concepts such as database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing and apply them to solve problems.
CO4 Develop a simple database system and analyze competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.
CO5 Evaluate the analyzed concept, including modelling and design</td></tr>
<tr><td colspan="7">COURSE SYLLABUS
Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Basic Concepts: [CO1]** File Systems vs. DBMS, Characteristics of the Database Approach, Abstraction and Data Integration, Database users, Advantages and Disadvantages of a DBMS. Database Systems Concepts and Architecture: Data Models, Schema and Instances, DBMS architecture and Data Independence, Database languages and Interfaces, DBMS functions and componen modules.	**10**
2	**[Course Objective(s) No.: 2]** **Entity-Relationship Model:** Entity Types, Entity Sets, Attributes & keys, Relationships, Relationships Types, Roles and Structural Constraints, Design issues, E-R Diagrams, Design of an E-R Database Schema, Reduction of an E-R Schema to Tables. **Relational Data Model:** Relational model concepts, Integrity constraints over Relations, Relational Algebra – Basic Operations. **SQL:** DDL, DML, and DCL, views & Queries in SQL, Specifying Constraints & Indexes in SQL.	**14**
3	**[Course Objective(s) No.: 3]** **Relational Database Design:** Functional Dependencies, Decomposition, Normal forms based on primary keys (1 NF, 2 NF, 3 NF, & BCNF). **Transaction Processing Concepts:** Introduction to Transaction Processing, Transaction & System Concepts, Properties of Transaction, Schedules and Recoverability, Serializability of Schedules. **Concurrency Control Techniques:** Locking Techniques, Timetamp ordering, Multi- version Techniques, Optimistic Techniques, Granularity of Data items.	**14**
4	**[Course Objective(s) No.: 4 & 5]** **Databases for Advanced Applications**: Active database concepts, Temporal database concepts, Spatial databases, Deductive databases; Emerging Database Technologies: Mobile databases, Multimedia Databases, Geographic information systems; XML and Internet Databases: Structured, Semi-structured and Unstructured Data, Introduction to web databases and XML, Structure of XML data.	**10**

Suggested Readings:

1. Connolly, T.M. and Begg, C.E., *Database Systems: A Practical Approach to Design, Implementation, and Management*, Pearson Education, 6th Ed. 2021.
2. Date, C.J., *An Introduction to Database Systems*, Pearson Education India, 8th Ed. 2012.
3. Elmasri, R., *Fundamentals of Database Systems*, Pearson Education India, 7th Ed. 2015.
4. Silberschatz, A., Korth, H.F. and Sudarshan, S., *Database System Concepts,* McGraw-Hill, 7th Ed. 2020.

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="5">Course Name:
Computer Networks</td><td colspan="2">Course Code:
CST404DM40</td></tr>
<tr><td>Programme: MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>Semester: II</td><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours:
48(L)+16(T) = 64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The main emphasis of this course is on the organization and management of local area networks. The course objectives include learning about computer network organization and obtaining a theoretical understanding of data communication and computer networks.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1: To learn about the basic concepts about Computer Network Modules
CO2: To understand network topologies, switching and transmission medium.
CO3: Apply the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
CO4: Analyse, specify and design the topological and routing strategies for an IP based networking infrastructure.
CO5: Evaluation of working knowledge of datagram and internet socket programming.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks

1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction To Computer Networks:** Definition of a Computer Network, The OSI Reference Model, The TCP/IP Reference Model, Protocols and Hardware involved in the OSI model, Comparison of the OSI and TCP/IP. **Application Layer:** Domain name space, DNS in internet, electronic mail, FTP, WWW, HTTP, SNMP, multimedia, network security.	**10**
2	**[Course Objective(s) No.: 2]** **Physical Layer:** Introduction: Network topologies; Linear Bus Topology, Ring Topology, Star Topology, Hierarchical or Tree Topology, Topology Comparison, Considerations when choosing a Topology: Switching; Circuit switching, Message switching, Packet switching. **Transmission Medium:** Introduction: Transmission medium; Guided & Unguided Transmission medium, Twisted pair, Coaxial cable, Optical fiber, Comparison of fiber optics and copper wire: Wireless transmission; Electromagnetic spectrum, Radio transmission, Microwave transmission.	**13**
3	**[Course Objective(s) No.: 3]** **Data Link Layer:** Design issues of DLL; Services provided to the Network layer, Framing, Error control, Flow control, ARQ strategies: Stop-and-Wait, RTT estimation, sliding window, Go-Back-N retransmission, Error Detection and correction: Parity bits, Single bit error correction or (n, m), Error Detection or Cyclic Redundant Code (CRC): Data Link layer protocols; Transmission control protocols, HDLC.	**12**
4	**[Course Objective(s) No.: 4 &5]** **Network Layer: Introduction:** Design issues of Network layer; Nature of the service provided, Internetworking: Principles of Routing; Types of routing algorithms, Properties of routing algorithms, Optimality principle: Routing algorithms; Shortest path algorithm, Flooding, Distance vector routing, Hierarchical routing, Link state routing, Congestion: Factors of congestion, Comparison of flow control and congestion control, General principles of congestion control, Closed loop	**13**

	solution: IP protocol (IPV4). **Transport Layer:** Introduction: Services of Transport layer; Service primitives: Connection establishment: Connection Release: Transport Protocols; TCP protocol, UDP protocol.	

Suggested Readings:

1. Comer, D.E., and Droms, R.E., *Computer Networks and Internets,* Prentice-Hall Inc., 6th Ed. 2015.

2. Forouzan, A.B., *Data Communications & Networking,* Tata McGraw-Hill Education, 5th Ed. 2017.

3. Kundu, S., *Fundamentals of Computer Networks*, PHI Learning Pvt. Ltd., 2nd Ed. 2018.

4. Kurose, J.F., *Computer Networking: A Top-Down Approach Featuring the Internet,* Pearson Education India, 7th Ed. 2016.

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="3">Course Name:
Design and Analysis of Algorithms</td><td colspan="3">Course Code:
CST406DM40</td></tr>
<tr><td>Programme: MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>Semester: II</td><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+16(T) = 64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The objective of this course is to reinforce basic design concepts (e.g., pseudo code, specifications, top-down design) and have the knowledge of algorithm design strategies. This course emphasizes mainly on the analysis of an algorithm w.r.t. time and space complexity.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Learn the basic concept of the asymptotic performance of algorithms.
CO2 To understand the write rigorous correctness proofs for algorithms.
CO3 Demonstrate familiarity with major algorithms and data structures and apply them to solve problems.
CO4 Analyse the real-life problems and their better solution.
CO5 Do evaluation of the analysed problem.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
<tr><td>1</td><td colspan="5">[Course Objective(s) No.: 1]
Introduction to analysis of algorithms: Analysis of algorithms, asymptotic notation-Big- O, Omega and Theta notations, recurrence relations, solving recurrences, Abstract data types, Linear Data Structures and their sequential storage representation: stacks, queues,</td><td>12</td></tr>
</table>

	priority queues, and their applications.	
2	**[Course Objective(s) No.: 2]** **Divide and Conquer:** General method, Binary Search, Exponentiation problem, Merge Sort, Quick Sort, Selection Sort, Strassen's Matrix Multiplication algorithms and analysis of algorithms for these problems. **Greedy Method:** General method, Knapsack Problem, Job sequencing with deadlines, Minimum Spanning trees, Single source shortest path and analysis of these algorithms.	**12**
3	**Dynamic Programming: [CO3]** General method, 0/1 Knapsack problem, Optimal BST, All Pairs shortest path, Traveling Salesman Problem, longest common subsequence (LCS). **Back Tracking:** General method, 8 queen's problem, graph coloring, Hamiltonian cycles and analysis of these problems.	**12**
4	**NP-Hard and NP-Complete Problems [CO4 & CO5]:** P, NP, NP-Hard & NP-Complete Classes, Reductions: Vertex cover, Simple Max-Cut, Hamiltonian Circuit, Traveling salesman problem, kernel, 3-dimensional matching, and other NP-Complete Problems, Satisfiability and variations, Cook's theorem, examples of NP-Hard problems.	**12**

Suggested Readings:

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., *Introduction to Algorithms,* MIT Press, 4th Ed. 2022.
2. Goodrich, M.T., Tamassia, R. and Mount, D.M., *Data Structures and Algorithms in C++*, John Wiley & Sons, 6th Ed. 2021.
3. Langsam, Y., Augenstein, M. and Tenenbaum, A.M., *Data Structures using C and C++,* Prentice Hall, 3rd Ed. 2021.
4. Lipschutz, S., *Schaum's Outline of Theory and Problems of Data Structures*, McGraw-Hill, 4th Ed. 2021.

Departmental Elective Courses-I & II

<table>
<tr><td>Scheme Version: 2025-Onwards</td><td colspan="5">Course Name:

Machine Learning Techniques</td><td colspan="2">Course Code:

CST416DS40</td></tr>
<tr><td rowspan="2">Programme: MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Machine Learning course aims to equip students with the fundamental knowledge and practical skills to develop and implement machine learning models for various applications. The core objectives typically include understanding different machine learning algorithms, data analysis techniques, model evaluation, and applying these skills to solve real-world problems.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:

CO1 Understand core concepts and mathematical foundations of machine learning algorithms.
CO2 Select and apply suitable algorithms for a given problem using real-world datasets.
CO3 Evaluate model performance using appropriate metrics and improve results through techniques such as feature selection and hyper parameter tuning.
CO4 Analyze the limitations and ethical implications of machine learning systems in real-world applications</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:

Maximum Marks = 70 Time: 3 Hours

Weightage per Unit = 14 marks

1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to Machine Learning:** Types of machine learning, Semi-supervised Learning, Active Learning, Reinforcement Learning, supervised learning-Basics, Concept of over fitting, under fitting. Feature engineering, The curse of dimensionality, Principal Component Analysis, Error Rates.	12
2	**[Course Objective(s) No.: 2]** **Linear and Logistic Regression:** Simple Linear Regression, Multiple Linear Regression, Linear regression: Optimization, Increasing the number of features, Overfitting and method Selection, linear classification: Characterizing a linear classifier, Training a linear classifier Logistic regression: Model, Classification, Bias and Variance. Cost Function, Multiclass Classification, Regularization, Model Evaluation, Cross-validation.	12
3	**[Course Objective(s) No.: 3]** **Support vector machines and Decision Trees (s):** Support Vector Machines, Hyperplane and Margin, Nonlinearity and Kernel Methods, Linear SVM, The soft margin SVM, The kernel trick. **Decision Trees**: Predictor form, Training Decision trees, Decision tree classifiers, Learning Decision trees, Decision stumps, Pruning.	12
4	**[Course Objective(s) No.: 4]** **Unsupervised learning technique:** Applications of Unsupervised Learning, Clustering K-Means Clustering, Hierarchical Clustering, DBSCAN (Density-Based Spatial Clustering of Applications with Noise), Evaluation of Clustering, Association Rule Learning, Anomaly Detection, Agglomerative, Gaussian Mixtures and Expectation-Maximization, Silhouette Score. **Ensemble Methods:** Ensemble Methods: Stacking (Stacked Generalization), Bagging (Bootstrap Aggregating) and Boosting, Random Forests, Voting Classifier.	12

Suggested Readings:

1. Mitchell, T. M. Machine Learning. McGraw Hill, 1997.
2. Bishop, C. M. Pattern Recognition and Machine Learning. Springer, 2006.
3. Géron, A.. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (3rd ed.). O'Reilly Media, 2022.
4. Alpaydin, E. Introduction to Machine Learning, MIT Press, 2020.

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="4">Course Name:

Foundations of Data Science</td><td colspan="2">Course Code:

CST418DS40</td></tr>
<tr><td rowspan="2">Programme:

MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week:5</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours:
48(L)+32(P) =80</td></tr>
<tr><td>Semester: II</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Foundations of Data Science course aims to provide a strong, conceptual understanding of the field, covering topics like data collection, preprocessing, exploration, and analysis. Students will learn to apply various statistical techniques and machine learning models to extract meaningful insights and make predictions from data.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Understand the data science lifecycle and identify the key steps involved in turning raw data into actionable insights.
CO2 Apply data cleaning and transformation techniques to prepare datasets for analysis.
CO3 Perform exploratory data analysis and visualize data using appropriate tools and techniques.
CO4 Use statistical methods and basic machine learning models to analyze data and interpret results.
CO5 Communicate findings effectively through visualizations, reports, and presentations while considering ethical implications and data integrity.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction:** Data Science, Data Science Lifecycle, Data Science vs. Data Analytics vs. Business Intelligence, Big Data and Data Science Relations between data and necessary linear algebraic operations. Distributed Databases, Application and purpose of data, Statistics: Descriptive Statistics: distributions and probability: Statistical Inference: Populations and samples – Statistical modeling, fitting a model: Hypothesis Testing. Learn Packages of R/ Python.	12
2	**[Course Objective(s) No.: 2]** **Data Wrangling and Exploration:** Data cleaning: Missing data, outliers, duplicates, Matrices, Factors, Data Frames, Vectors, Lists, Data Cleaning and reading data from different data source, Reading Large Tables, Subsetting and Sorting, Summarizing Data, Creating New Variables, Reshaping Data, Managing Data Frames with dplyr – Introduction, Managing Data Frames with dplyr - Basic Tools, Merging Data, Data Science Process.	12
3	**[Course Objective(s) No.: 3]** **Data Visualization:** Introduction, Types of Data: Categorical, numerical, time series, and geographic data, Chart Types: Bar charts, pie charts, histograms, Line charts, scatter plots, box plots, heatmaps, Choropleth and Bubble maps, Visualization Tools and Libraries: Matplotlib: Basic plotting, figure customization, annotations; Seaborn: Statistical plotting, themes, color palettes; Plotly, ggplot	12
4	**[Course Objective(s) No.: 4 & 5]** **Interactive Visualization and Dashboards:** Introduction, Dashboard Design Principles, Data import and preparation, building dashboards with filters, slicers, and calculated fields, Publishing and sharing dashboards Python Dash or Streamlit: Basic layout creation and interactive elements, Connecting to live data (e.g., via APIs or databases), Hosting and deployment (local and cloud)	12

Suggested Readings:

1. Provost, F., & Fawcett, T., *Data science for business: What you need to know about data mining and data-analytic thinking*. O'Reilly Media, 2013.
2. Kieran Healy, *Data Visualization: A Practical Introduction,* Princeton University Press, 2018
3. McKinney, W., *Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter*, O'Reilly Media, 3rd Ed. 2022.
4. Cole Nussbaumer Knaflic, *Storytelling with Data: A Data Visualization Guide for Business Professionals,* Wiley, 1st Ed. 2015

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="4">Course Name:
Data Warehousing and Data Mining</td><td colspan="2">Course Code:
CST422DS40</td></tr>
<tr><td rowspan="2">Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours:
48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The main objective of this course is to impart the knowledge on how to implement classical models and algorithms in data warehousing and data mining and to characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering. Data quality and methods and techniques for pre-processing of data.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Comprehend the various architectures and its application with data mining.
CO2 To understand the design and develop data mining algorithms to analyze raw real-world data
CO3 Monitor and apply to predict online digital activities and solve problem using them.
CO4 Analyse and Evaluate various mining techniques on complex data objects</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** Basic Concepts, Data Warehousing Components, Building a Data Warehouse, Database Architectures for Parallel Processing, Parallel DBMS Vendors, Multidimensional Data Model, Data Warehouse Schemas for Decision Support, Concept Hierarchies, Characteristics of OLAP Systems, Typical OLAP Operations, OLAP and OLTP.	10
2	**[Course Objective(s) No.: 2]** Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, Applications, Data Objects and attribute types, Statistical description of data, Data Preprocessing, Cleaning, Integration, Reduction, Transformation and Discretization, Data Visualization, D a t a similarity and dissimilarity measures.	16
3	**[Course Objective(s) No.: 3]** Mining Frequent Patterns, Associations and Correlations, Mining Methods, Pattern Evaluation Method, Pattern Mining in Multilevel, Multi-Dimensional Space, Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns	10
4	**[Course Objective(s) No.: 4]** Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Back Propagation, Support Vector Machines, Lazy Learners, Model Evaluation and Selection, Techniques to improve Classification Accuracy, Clustering Techniques, Cluster analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods.	12

Suggested Readings:

1. Berson, A. and Smith, S.J., *Data Warehousing, Data Mining & OLAP*, Tata McGraw Hill, 3rd Ed. 2017.
2. Jiawei Han, Micheline Kamber and Jian Pei, *Data Mining Concepts and Techniques*, Elsevier, 3rd Ed. 2011.
3. Pujari, A.K., *Data Mining Techniques*, Universities Press, 3rd Ed. 2013.
4. Ian H. Witten, Eibe Frank and Mark A. Hall, *Data Mining: Practical Machine Learning Tools and Techniques*, Elsevier, 5th Ed. 2016

<table>
<tr><td>Scheme Version: 2025-Onwards</td><td colspan="4">Course Name:
Network Security</td><td colspan="2">Course Code:
CST424DS40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Network Security course aims to equip students with the knowledge and skills to understand, identify, and mitigate network security threats. It focuses on securing data, systems, and networks against unauthorized access, misuse, or damage. The course covers various topics like cryptography, security protocols, intrusion detection, and firewall technologies.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">After completing this course, the student will be able to:
CO1 Understand network security fundamentals.
CO2 Analyze cryptographic systems.
CO3 Identify and evaluate network threats.
CO4 Implement security mechanisms.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
<tr><td>1</td><td colspan="5">[Course Objective(s) No.: 1]
Network Security: Attacks, Services and Mechanisms, Security Attacks, Security Services, Integrity check, digital Signature, authentication, Authentication, Password Based, Address Based, Cryptographic Authentication. Passwords in distributed systems, on-line vs offline guessing, storing. Cryptographic Authentication: passwords as keys, protocols, KDC’s Certification Revocation, Authentication of</td><td>12</td></tr>
</table>

	People, Verification techniques, passwords, length of passwords, password distribution, smart cards, biometrics.	
2	**[Course Objective(s) No.: 2]** **Secret Key Cryptography:** Block Encryption, DES rounds, S-Boxes IDEA: Overview, comparison with DES, Key expansion, IDEA rounds, Uses of Secret key Cryptography; ECB, CBC, OFB, CFB, Multiple encryptions DES.	**10**
3	**[Course Objective(s) No.: 3]** **Hash Functions and Message Digests:** Length of hash, uses, algorithms (MD2, MD4, MD5, SHS) MD2: Algorithm (Padding, checksum, passes.) MD4 and 5: algorithm (padding, stages, digest computation.) SHS: Overview, padding, stages.	**12**
4	**[Course Objective(s) No.: 4]** **Public key Cryptography:** Public Key encryption, Algorithms, Modular arithmetic (addition, multiplication, inverse, and exponentiation) RSA: generating keys, encryption and decryption. Public Key Cryptosystem – Message Authentication and Hash Functions – Hash and MAC Algorithms – Digital Signatures and Authentication Protocols. **Other Algorithms:** PKCS, Diffie-Hellman, El-Gamal signatures, DSS, Zero-knowledge signatures. **Threats in Networks:** Network Security Controls, Firewalls, Web Security, Electronic mail security, IP security, Network management security, Security for electronic commerce: SSL, SET, System Security, Intruders and Viruses, Firewalls, Intrusion Detection.	**14**

Suggested Readings:

1. Kaufman, c., Perlman, R., and Speciner, M., *Network Security, Private Communication in a public world*, Prentice Hall PTR, 2nd Ed. 2002.
2. Charles B. Pfleeger - Shari Lawrence Pfleeger, *Security in Computing*, Pearson Education, 3rd Ed. 2003.
3. William Stallings, *Cryptography and Network Security – Principles and Practices*, Pearson Education,4th Ed. 2003.
4. Stallings, W., *Cryptography and Network Security: Principles and Practice*, Prentice Hall PTR, 3rd Ed. 2003.

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="4">Course Name:
Cryptography</td><td colspan="2">Course Code:
CST426DS40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester:
II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The primary learning objectives in Cryptography involve understanding core concepts, various algorithms, and their practical applications in securing digital information. This includes grasping confidentiality, integrity, authentication, and non-repudiation, as well as understanding different cryptographic techniques like encryption, hashing, and digital signatures.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Understanding of the Cryptography and security trends.
CO2 Understanding of different services provided by the various cryptographic techniques Symmetrical and Asymmetrical Cryptography, their applications and standards, Understanding of the Data integrity, Authentication, and Digital Signatures.
CO3 Understand the principles and practices of cryptographic techniques.
CO4 Understand information security goals for designing secure systems.
CO5 Apply security algorithms in solving real-life security problems in communicating systems.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to Cryptography:** Information Security understanding, Security goals, Security Attacks, Security Services, Security Mechanisms, Security Trends, The OSI Security Architecture, Steganography, A Model for Network Security, Recommended Reading and Web Sites. Symmetric Ciphers Classical Encryption Techniques, Substitution, Transposition Techniques, Steganography.	10
2	**[Course Objective(s) No.: 2]** **Data Encryption and Advanced Encryption Techniques:** Data Encryption Standard, Block Cipher Principles, Modes of operation, Symmetric cipher model, substitution Ciphers, transposition Ciphers, Evaluation Criteria for AES, AES Cipher-Encryption and Decryption, Encryption Round, Differential and Linear Cryptanalysis, Block Cipher Design Principles. Finite Fields- Groups, Rings, Modular Arithmetic, The Euclidean Algorithm, Multiple Encryption and Triple DES, Stream Ciphers and RC4.	13
3	**[Course Objective(s) No.: 3]** **Public Key Cryptography and Modern Symmetric Key Ciphers:** Symmetric and public key Encryption, Key Management, Placement of Encryption Function, Authentication Requirement, Authentication Functions, Message Authentication Code, Traffic Confidentiality, Key Distribution, Random Number Generation, Principles of Public Key Cryptosystem, RSA algorithm, Diffie Hellman Key exchange. Electronic code book mode, CBC, Cipher Feedback mode, output Feedback Mode.	12
4	**[Course Objective(s) No.: 4 & 5]** **Web and System Security:** Web security Considerations, Digital Signatures and Authentication Protocols, Digital Signature Standard, Authentication Requirements, Authentication Functions, Message Authentication Codes, Security of Hash Functions and MACs. Message Authentication, Types of Firewall and Firewall Configuration. Firewall Design Principles- Characteristics, Intruders, Intrusion Detection, Secure Socket layer (SSL) and Transport Layer Security (TLS); Secure Electronic Transaction (SET), Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	13

Suggested Readings:

1. William Stallings, *Cryptography and Network Security: Principals and Practice*, Pearson, 8th Ed. 2022
2. Jonathan Katz, Yehuda Lindell, *Introduction to Modern Cryptography*, CRC Press, 3rd Ed. 2020
3. Dan Boneh, Victor Shoup, A Graduate Course in Applied Cryptography, 2020
4. Christof Paar, Jan Pelzl, *Understanding Cryptography: A Textbook for Students and Practitioners*, Springer 1st Ed. 2010

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="5">Course Name:
Information Systems Security</td><td colspan="2">Course Code:
CST428DS40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The objective of the Information Systems Security course is to provide students with a comprehensive understanding of the principles, practices, and technologies used to protect information systems from unauthorized access, disruption, or destruction. The course aims to equip learners with the knowledge and skills required to identify security threats, implement security measures, and ensure the confidentiality, integrity, and availability of information within an organization.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="7">The outcomes reflect the knowledge and skills students should acquire by the end of the course:
CO1 Understanding of fundamental information security concepts, principles, and frameworks, including confidentiality, integrity, availability, and authentication.
CO2 Knowledge of Security Threats and Vulnerabilities.
CO3 Security Mechanisms and Controls.
CO4 Risk Management and Compliance.
CO5 Security Management and Policies.</td></tr>
<tr><td colspan="8">COURSE SYLLABUS</td></tr>
<tr><td colspan="8">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Information Security:** Need for Information Security, Privacy, Firewall, Attributes of Information Security, Aspect of Security, Confidentiality, Data Integrity, Availability, Protection Virus Security, Non-Repudiation, Authentication, Data Encryption Techniques, Hashing.	10
2	**[Course Objective(s) No.: 2]** **Security Threats, Services, Mechanism and Attacks:** Access Control, Program Threats, Worms, Viruses, Trojan Horse, Stack and Buffer Overflow, System Threats-intruders, Communication Threats Tapping and Piracy, and Vulnerabilities, Security Attacks, Malicious Software, Authentication, Password Vulnerabilities and Attacks, Substitution, Transposition Ciphers, Symmetric key algorithms, Public key Encryption RSA, Diffie-Hellman Key Exchange, Biometrics, Antivirus Installation, Password Management, User Account Controls (Windows), Biometrics Techniques.	13
3	**[Course Objective(s) No.: 3]** **Physical and System Security:** Function of Operating System, Windows Weakness, Hardening OS during Installation, Secure user Account Policy, Patching Software, Hardening Windows, Active Directory / Kerberos, Vulnerability Scanning, Manual and Automatic Hardening.	12
4	**[Course Objective(s) No.: 4 & 5]** **Cyber Security and Cyber Law:** Cyberspace, Cyber Crimes, Cyber Criminals, Cyber Security, Cyber Security Threats, DoS Attack, Vulnerability, Analysis, Intrusion Detection System, Web Servers and Browsers, Caching, Plug-in, ActiveX, Secure Socket Layer (SSl), Secure Electronic Transaction (SET), Email Risks, Email Protocols, Email Security, Digital Signature, Setting up Browser Security, Email Encryption. IT Act 2000, Legal Provisions under the IT Act.	13

Suggested Readings:

1. William Stallings & Lawrie Brown, *Computer Security: Principles and Practice,* Pearson, 4th Ed. 2018
2. M. E. Whitman & H. J. Mattord, *Principles of Information Security,* CENGAGE,7th Ed. 2022
3. Nina Godbole, *Information Systems Security: Security Management, Metrics, Frameworks and Best Practices*, Wiley India, 2nd Ed. 2018
4. Mark Stamp & Ashutosh Saxena, Information Security: Principles and Practice (An Indian Adaptation), Wiley India, 3rd Ed. 2021

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="4">Course Name:

Computer Graphics</td><td colspan="2">Course Code:

CST432DS40</td></tr>
<tr><td>Programme:

MCA</td><td>Total Marks: 100

CIE: 30</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>TEE: 70</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours:
48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The main objective of this course is to introduce the concepts of computer graphics to the students. It starts with an overview of interactive computer graphics, two-dimensional system and mapping, then it presents the most important drawing algorithm, two- dimensional transformation; Clipping, filling and an introduction to 3-D graphics.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Describe the basic concepts of computer graphics.
CO2 To implement various scan conversion problems with programming.
CO3 Apply various transformations on the digital drawings.
CO4 Analyse various modelling techniques in multimedia object creation.
CO5 Graphics evaluation and shading in 3D transformation.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:

Maximum Marks = 70 Time: 3 Hours

Weightage per Unit = 14 marks

1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction:** History of Computer Graphics (CG), Applications of Computer Graphics, Components of interactive graphics systems, Display devices: Refresh CRT, Color CRT, Plasma Panel displays LCD Panels, Raster-scan System, Random scan System, Graphic software, Input/output Devices, Tablets.	12
2	**[Course Objective(s) No.: 2]** **Output Primitives:** Points and Lines, Line Drawing Algorithms: DDA algorithm, Bresenhams algorithm, Circle drawing algorithms: Polynomial Method, Bresenhams algorithm. Parametric representation of Cubic Curves, Bezier Curves.	10
3	**[Course Objective(s) No.: 3]** **2D Transformation:** Use of Homogeneous Coordinates Systems, Composite Transformation: Translation, Scaling, Rotation, Mirror Reflection, Rotation about an Arbitrary Point. Clipping and Windowing, Clipping Operations. Line Clipping Algorithms: The Mid-Point subdivision method, Cohen-Sutherland Line Clipping Algorithms, Polygon Clipping, Sutherland Hodgeman Algorithms, Text Clipping	14
4	**[Course Objective(s) No.: 4 & 5]** **3-D Graphics:** 3-D object representations, 3-D Transformations: Translation, Rotation, Scaling, Projections, Hidden surface elimination: Back face removal, Dept Buffer algorithm, Scan-line algorithm, Dept sort algorithm, Shading	12

Suggested Readings:

1. Foley, J. D., Van Dam, A., Feiner, S. K., and Hughes, J. F**.** *Computer Graphics – Principles and Practice*. Second Edition in C, Pearson Education, 2003.
2. Hearn, D. and Baker, M. Pauline. *Computer Graphics (C Version)*. 2nd Edition, Pearson Education, 2004.
3. Rogers, D. F. and Adams, J. A. *Mathematical Elements for Computer Graphics*. 2nd Edition, McGraw-Hill International Edition, 1990.
4. Hill Jr., F. S. *Computer Graphics using OpenGL*. Pearson Education, 2003.

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="4">Course Name:
Digital Image Processing</td><td colspan="2">Course Code:
CST434DS40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester:
II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">In this course, students will understand the image fundamentals and mathematical transforms necessary for image processing. Study about the image enhancement techniques, image restoration procedures and image compression procedures. Students will learn about the image segmentation and representation techniques & pattern recognition and interpretation.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 On completion of the module the student will be able to:
CO2 Explain and analyse the steps of image formation, sampling, quantization and representation digitally. Outline and understand how images are processed by discrete, linear, time-invariant systems.
CO3 Apply how images are perceived by humans and how colour is represented and solve problems. Analysing how image information can be modelled analytically and compare transform- domain representation of images (Fourier, DCT, Haar, WHT).
CO4 Evaluation of descriptors.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1 Question Paper will consist of five questions.
2 Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3 Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction and Digital Image Fundamentals:** The origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels, Linear and Non-Linear Operations.	12
2	**[Course Objective(s) No.: 2]** **Image Enhancement in the Spatial Domain:** Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. **Image Enhancement in the Frequency Domain:** Introduction to Fourier Transform and the Frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.	14
3	**[Course Objective(s) No.: 3]** **Image Restoration:** A model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. **Image Compression:** Coding, Interpixel and Psychovisual Redundancy, Image Compression models, Elements of Information Theory, Error free comparison, Lossy compression, Image compression standards.	12
4	**[Course Objective(s) No.: 4]** **Image Segmentation:** Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion based segmentation. **Representation and Description:** Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms. **Object Recognition:** Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods.	10

Suggested Readings:

1. Gonzalez, R. C. and Woods, R. E. *Digital Image Processing,* 3rd Edition, Pearson Education, 2009.
2. Jain, Anil K**.** *Fundamentals of Digital Image Processing,* Prentice Hall, 1989.
3. Bovik, A. C. *The Essential Guide to Image Processing,* Academic Press, 2nd Ed. 2009.
4. Tekalp, A. M. *Digital Video Processing,* Prentice Hall PTR, 1995

<table>
<tr><td>Scheme
Version:
2025-
Onwards</td><td colspan="4">Course Name:
Information Retrieval</td><td colspan="2">Course Code:
CST436DS40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours:
48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Information Retrieval enables students to understand the various aspects of an Information retrieval system and its evaluation and to be able to design. This module aims to give students an understanding of the fundamental techniques for hypermedia architectures, design and usability, document management and retrieval, metadata management, and searching the web.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Understanding the basics of Information Retrieval.
CO2 Realize the data structures like Inverted Indices used in Information retrieval systems.
CO3 Realize the concepts of agile methods and software testing.
CO4 Learn the different techniques for compression of an index including the dictionary and its posting list.
CO5 Understanding the data structures like Inverted Indices used in Information retrieval systems.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to Information Retrieval Systems:** Definition of Information Retrieval System, Objectives of Information Retrieval Systems. **Functional Overview:** Item Normalization, Selective Dissemination of Information, Document, Index and Multimedia Database Search. Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities, Z39.50 and WAIS Standards.	12
2	**[Course Objective(s) No.: 2]** **Cataloging and Indexing:** History and Objectives of Indexing, Indexing Process, Scope of Indexing, Precoordination and Linkages, Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing Natural Language, Concept Indexing, Hypertext Linkages, Information Extraction, Index Compression: Dictionary Compression, Posting File Compress.	12
3	**[Course Objective(s) No.: 3]** **User Search Technique:** Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext. Computing Scores in a Complete Search System: Efficient Scoring and Ranking, Components of an Information Retrieval System.	12
4	**[Course Objective(s) No.: 4 & 5]** **Evaluation in Information Retrieval:** Standard Test Collections, Evaluation of Unranked Retrieval Sets, Evaluation of Ranked Retrieval Results, Assessing Relevance, System Quality and User Utility. Information Visualization: Cognition and Perception, Aspects of Visualization Process, Information Visualization Technologies.	12

Suggested Readings:

1. Manning, Christopher D., Raghavan, Prabhakar, and Schütze, Hinrich. *An Introduction to Information Retrieval,* Cambridge University Press, 1st Ed. 2008.
2. Chowdhury, G. G. *Introduction to Modern Information Retrieval*. Neal-Schuman Publishers, 3rd Ed. 2010.
3. Kowalski, Gerald J. and Maybury, Mark T. *Information Storage and Retrieval Systems: Theory and Implementation*. Kluwer Academic Publishers, 2nd Ed. 2009.
4. Madhavi Vaidya, Yashowardhan Sowale, Information Retrieval, Wiley, 2021

<table>
<tr><td>Scheme Version: 2025- Onwards</td><td colspan="4">Course Name:
Advanced Computer Architecture</td><td colspan="2">Course Code:
CST438DS40</td></tr>
<tr><td>Programme: MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to develop understanding in the advanced design principles of a computer system by addressing key issues such as instruction set design, micro-architecture of scalar and superscalar processors along with the interaction of other hardware components in a computer system. In this course, there is a strong emphasis on the study of various constraints in the design of single and multi-processor systems. Students will complete this course with an appreciation and understanding of processor design issues relating to simplicity of implementation, performance-enhancement techniques, and power-reduction methods.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Classify and compare parallel computer architectures.
CO2 Analyze and apply techniques for instruction, thread, and data-level parallelism.
CO3 Evaluate performance and reliability in advanced architectures.
CO4 Discuss trends in heterogeneous and GPU-based computing.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to Parallel Processing and Instruction-Level Parallelism (ILP) Concepts:** Program, process, thread, concurrent & parallel languages Classification of parallel architectures Parallelisation techniques and their applications. Instruction-Level Parallelism: dependencies & hazards (data, control, resource), Dynamic scheduling, compiler techniques for ILP, speculation, sequential consistency, ILP approaches: Pipelined, VLIW, and superscalar processors-principles, structures, performance	12
2	**[Course Objective(s) No.: 2]** Thread-Level Parallelism and MIMD Architectures, MIMD architecture and classification, Shared-memory & distributed-memory MIMD: cache coherence, synchronization, memory consistency, interconnection topologies, Multithreaded architectures: Von Neumann- based, data-flow based, hybrid.	12
3	**[Course Objective(s) No.: 3]** Data-Level Parallelism and SIMD Architectures, Data-parallel architectures, connectivity, loop-level parallelism, SIMD architecture: granularity, connectivity, complexity, autonomy, Vector architecture: word length, vectorization, pipelining, parallel computing streams, Systolic architectures: dimensionality, precision, programmability, connectivity, synchronicity.	12
4	**[Course Objective(s) No.: 4]** **Advanced Topics: Memory hierarchy and performance, Multiprocessor systems:** interconnection networks, NUMA, SMP, Fault tolerance and reliability in advanced architectures, Emerging trends: GPUs, heterogeneous computing.	12

Suggested Readings:

1. J.L.Hennessy, D.A.Patterson, Computer Architecture: a quantitative approach, Morgan Kaufmann, 5th Ed. 2011
2. William Stallings, Computer Organization and Architecture, Prentice Hall, 10th Ed. 2015
3. Patterson, J.L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann, 5th Ed. 2013
4. C. Hamacher, Z. Vranesic and S. Zaky, Computer Organization, McGraw-Hill, 5th Ed. 2002

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="3">Course Name:
Cloud Computing</td><td colspan="2">Course Code:
CST442DS40</td></tr>
<tr><td>Programme:
MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L)+32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Cloud Computing course aims to provide students with a comprehensive understanding of cloud computing concepts, technologies, and practices. Specifically, courses often cover cloud architecture, deployment models, security, and various cloud services. The goal is to equip students with the knowledge and skills to effectively use and manage cloud resources for various applications.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Describe cloud service and deployment models.
CO2 Explain cloud architecture and virtualization techniques.
CO3 Evaluate cloud service providers and address security concerns.
CO4 Apply cloud programming models and discuss emerging technologies.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
<tr><td>1</td><td colspan="5">[Course Objective(s) No.: 1]
Introduction to Cloud Computing: Definition, characteristics, service models (IaaS, PaaS, SaaS), Deployment models: public,</td><td>12</td></tr>
</table>

	private, hybrid, community clouds, Benefits, challenges, and applications.	
2	**[Course Objective(s) No.: 2]** **Architecture:** Cloud Architecture and Virtualization, Cloud architecture: components, resource pooling, scalability, Virtualization: types, hypervisors, virtual machines, storage virtualization.	**12**
3	**[Course Objective(s) No.: 3]** **[**Cloud Services and Security, Cloud service providers : AWS, Azure, Google Cloud, Cloud storage, databases, networking, Security issues: data privacy, compliance, identity management.	**12**
4	**[Course Objective(s) No.: 4]** Cloud Application Development and Trends**:** Cloud programming models and tools, Migration to cloud, multi-cloud strategies, Emerging trends: serverless computing, edge computing, containers.	**12**

Suggested Readings:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, *Cloud Computing: Principles and Paradigms*, Wiley, 2011
2. Nikos Antonopoulos, Lee Gillam, *Cloud Computing: Principles, Systems and Applications*, Springer, 2012
3. Ronald L. Krutz, Russell Dean Vines, *Cloud Security: A Comprehensive Guide to Secure Cloud Computing*, Wiley-India, 2010
4. Barrie Sosinsky, *Cloud Computing Bible*, Wiley-India, 2010

Scheme Version: 2025- Onwards	**Course Name:** **Quantum Computing**				**Course Code:** **CST444DS40**	
Programme: **MCA**	**Total Marks: 100** **CIE: 30** **TEE: 70**	**L**	**T**	**P**	**Credits**	**Contact Hours per Week: 5**
Semester: II		**3**	**0**	**2**	**4.0**	**Total Hours: 48(L) + 32(P) = 80**
Course Objectives	The course aims to serve as an introduction to the quantum computational model with the goal of understanding basic quantum algorithms and analyzing them. The course also addresses the limitations of quantum algorithms and introduces the necessary tools and techniques to prove the same.					
Course Outcomes:	**CO1** Explain the differences between classical and quantum computation. **CO2** Analyze and implement basic quantum algorithms. **CO3** Describe quantum hardware and error correction techniques. **CO4** Evaluate current applications and challenges in quantum computing.					

COURSE SYLLABUS

Instructions for the paper-setter:

Maximum Marks = 70 Time: 3 Hours

Weightage per Unit = 14 marks

1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.

Unit No.	**Content of Each Unit**	**Hours of Each Unit**
1	**[Course Objective(s) No.: 1]** Foundations of Quantum Computing, Classical vs. quantum computation, Qubits, superposition, entanglement, Quantum gates and circuits.	**12**

2	**[Course Objective(s) No.: 2]** Quantum Algorithms, Quantum parallelism, Deutsch-Jozsa algorithm, Grover's search algorithm, Shor's factoring algorithm.	**12**
3	**[Course Objective(s) No.: 3]** Quantum Hardware and Implementation, Physical realization of qubits: ion traps, superconducting circuits, quantum dots, Quantum error correction, Quantum programming languages and simulators.	**12**
4	**[Course Objective(s) No.: 4]** Applications and Challenges, Quantum cryptography, quantum communication, Current status and future directions, Challenges: decoherence, scalability, error rates.	**12**

Suggested Readings:

1. Michael A. Nielsen & Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge Press, 10th Anniversary Edition,
2. N. David Mermin, *Quantum Computer Science: An Introduction* Cambridge University Press, 1st Ed. 2007
3. I. Chuang and M.Nielsen, *Quantum Computation and Quantum Information*, Cambridge University Press, 2012
4. Jack D. Hidary, Quantum Computing: An Applied Approach, Springer International Publishing, 1st Ed. 2019

<table>
<tr><td>Scheme Version: 2025- Onwards</td><td colspan="4">Course Name:
Web Development</td><td colspan="2">Course Code:
CST448DS40</td></tr>
<tr><td>Programme: MCA</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to understand the structure and working of the World Wide Web and core web protocols. It will help to learn the principles of effective web design and implement them using HTML and CSS. Also, it aims to develop dynamic and interactive web applications using JavaScript, PHP, and MySQL and to explore data handling and transformations through XML and database integration techniques.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">After completion of this course, the students will be able to:
CO1 Understand the structure and working of the World Wide Web and core web protocols.
CO2 Learn the principles of effective web design and implement them using HTML and CSS.
CO3 Develop dynamic and interactive web applications using JavaScript, PHP, and MySQL.
CO4 Explore data handling and transformations through XML and database integration techniques.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:

Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction:** Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of latest version of Web. **Web Design**: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.	11
2	**[Course Objective(s) No.: 2]** **HTML**: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of latest version of HTML. **Style sheets**: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of of latest version of CSS.	12
3	**[Course Objective(s) No.: 3]** **JavaScript**: Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: Javascript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML: Combining HTML, CSS and Javascript, Events and buttons.	12
4	**[Course Objective(s) No.: 4]** **XML**: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT. **PHP**: Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions. **PHP and MySQL**: Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database	13

	bugs.	

Suggested Readings:

1. B. M. Harwani, Developing Web Applications in PHP and AJAX, Tata McGraw-Hill, 2010.
2. Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, and Abbey Deitel, Pearson Education, 5th Ed. 2011.
3. Ralph Moseley and M. T. Savaliya, Developing Web Applications, Wiley-India Private Limited, 2011.
4. Robert W. Sebesta, Programming the World Wide Web, Pearson Education,7th Ed. 2013.

<table>
<tr><td>Scheme Version: 2025-Onwards</td><td colspan="4">Course Name:

Android Applications Development</td><td colspan="2">Course Code:

CST452DS40</td></tr>
<tr><td>Programme:

MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Android application development course aims to equip students with the skills and knowledge to create apps for the Android operating system. The course objectives often include understanding the Android SDK, learning basic application development concepts, working with Android Studio, and gaining proficiency in designing and developing user interfaces.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">CO1 Identify various concepts of mobile programming that make it unique from programming for other platforms,
CO2 Critique mobile applications on their design pros and cons,
CO3 Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces,
CO4 Program mobile applications for the Android operating system that use basic and advanced phone features, and
CO5 Deploy applications to the Android marketplace for distribution.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
<tr><td>1</td><td colspan="5">[Course Objective(s) No.: 1]
Introduction to Android: The Android Platform, Android SDK,</td><td>11</td></tr>
</table>

	Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.	
2	**[Course Objective(s) No.: 2]** **Android Application Design Essentials:** Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.	**12**
3	**[Course Objective(s) No.: 3]** **Android User Interface Design Essentials**: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.	**12**
4	**[Course Objective(s) No.: 4 & 5]** **Using Common Android APIs**: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.	**13**

Suggested Readings:

1. Lauren Darcey and Shane Conder, *Android Wireless Application Development*, Pearson Education, 2nd Ed. 2011
2. Prasanth Kumar Pattnaik, Rajib Mall, *Fundamentals of Mobile Computing*, PHI Learning, 2012
3. Bill Phillips, Chris Stewart and Kristin Marsicano, *Android Programming: The Big Nerd Ranch Guide*, Big Nerd Ranch Guides, 4th Ed. 2019
4. Dawn Griffiths and David Griffiths, *Head First Android Development*, O"Reilly Publishers,1st Ed. 2015

<table>
<tr><td>Scheme Version: 2025-Onwards</td><td colspan="4">Course Name:

Cloud & DevOps</td><td colspan="2">Course Code:

CST454DS40</td></tr>
<tr><td>Programme:

MCA</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>Semester: II</td><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to equip learners with an understanding of various cloud service and deployment models, virtualization techniques, and the architecture of modern cloud platforms like AWS, Azure, and Google Cloud. The course also introduces DevOps principles including continuous integration, continuous delivery, infrastructure as code, and configuration management. Students will develop hands-on skills in containerization, orchestration, monitoring, and cloud security practices to effectively manage scalable and reliable cloud-native systems.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">After completion of this course, the students will be able to:
CO1 Understand core concepts and architecture of cloud computing and its service models.
CO2 Gain hands-on experience with cloud platforms like AWS, Azure, and GCP.
CO3 Learn and apply DevOps tools and practices for automation and continuous delivery.
CO4 Design, deploy, and manage scalable cloud-native applications with security and monitoring.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
</table>

1	**[Course Objective(s) No.: 1]** **Cloud Computing Basics**: Definition and Characteristics of Cloud, Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community **Virtualization Concepts**: Hypervisors: Type I and II, Virtual Machines and Containers, Virtualization vs Cloud **Cloud Providers Overview**: AWS, Microsoft Azure, Google Cloud, Service Comparison **Cloud Architecture**: Multi-Tenant Architecture, Elasticity, Scalability, High Availability	**13**
2	**[Course Objective(s) No.: 2]** **Compute Services**: AWS EC2, Azure Virtual Machines, GCP Compute Engine **Storage Services**: Object Storage (S3, Blob), Block Storage, File Storage **Networking in Cloud**: Virtual Private Cloud (VPC), Subnets, Internet Gateway, Load Balancers, CDN, DNS (Route 53) **Platform Services**: Serverless Computing: AWS Lambda, Azure Functions, Containers & Orchestration: Docker, Kubernetes Basics	**12**
3	**[Course Objective(s) No.: 3]** **Introduction to DevOps**: Principles, Lifecycle, and Cultural Aspects, DevOps vs Traditional IT **Source Code Management**: Git Basics, GitHub/GitLab/Bitbucket Usage **CI/CD Concepts**: Continuous Integration, Continuous Delivery, Continuous Deployment, Jenkins, GitHub Actions, GitLab CI **Infrastructure as Code (IaC)**: Introduction to Terraform / AWS Cloud Formation, Configuration Management: Ansible, Puppet, Chef.	**12**
4	**[Course Objective(s) No.: 4]** **Containerization & Orchestration**: Docker: Images, Containers, Dockerfiles, Volumes, Networks, Kubernetes: Pods, Services, Deployments, Helm (intro) **Monitoring & Logging**: Monitoring Tools: Prometheus, Grafana, Log Management: ELK Stack, CloudWatch **Cloud Security Basics**: Identity and Access Management (IAM), Encryption, Secure APIs, Shared Responsibility Model	**11**

Suggested Readings:

1. Justin Domingus & John Arundel, Cloud Native DevOps with Kubernetes, O'Reilly Media, 2nd Ed., 2022
2. Gene Kim, Patrick Debois, John Willis, Jez Humble, *The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations*, IT Revolution Press,1st Ed. 2016
3. Sumit Kapoor, *AWS DevOps Engineer Professional Certification Guide*, BPB Publications, 2024
4. Kelsey Hightower, Brendan Burns, Joe Beda, *Kubernetes Up & Running: Dive into the Future of Infrastructure*, O'Reilly Media, 1st Ed. 2017

List of Multi-Disciplinary Courses

<table>
<tr><td>Scheme Version:
2025-onwards</td><td colspan="3">Course Name:
Fundamentals of Computer Science</td><td colspan="2">Course Code:
CST110MD40</td></tr>
<tr><td rowspan="2">Programme:
P.G./U.G.
(Multi-Disciplinary Course)</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+16(T) =64</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course aims to give students an in-depth understanding of why computers are essential components in business, education and society. This course will provide hands-on use of Microsoft Office applications Word, Excel, Access and PowerPoint.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="5">Upon successful completion of the course students will be able to:
CO1 Learn about the fundamental concepts of computer.
CO2 To understand the role of Internet and IPV4 and IPV6.
CO3 Apply the binary logics to solve the problems.
CO4 Analyse Boolean logics and truth table.
CO5 Evaluate tasks like compose, format and edit a word document and other office software.</td></tr>
<tr><td colspan="6">COURSE SYLLABUS</td></tr>
<tr><td colspan="6">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="4">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
<tr><td>1</td><td colspan="4">[Course Objective(s) No.: 1]
Overview of Computer System: Evolution of Computer</td><td>11</td></tr>
</table>

	Systems, Generations of Computers, Parts of Computer System, Categories of Computers, Computer System Characteristics, Computer Hardware. Working of input & output devices: keyboard, mouse, trackball, pen, touch screens, scanner, digital camera, monitor, and printer. Working of storage devices: magnetic tape, magnetic disk, CD, DVD. Software- System & Application	
2	**[Course Objective(s) No.: 2]** **The Internet:** Introduction to networks and internet, history, Working of Internet, Internet Congestion, Modes of Connecting to Internet, Internet Service Providers (ISPs), Internet addressing, comparison of IPv4 and IPv6.	**10**
3	**[Course Objective(s) No.: 3]** **Information Representation:** Number systems, BCD codes, character codes, error detecting and correcting codes, fixed-point and floating-point representation of information. Binary arithmetic operations, Booths multiplication. **Binary Logic:** Boolean algebra, Boolean functions, Truth Tables, Canonical and Standard forms, Simplification of Boolean functions, Digital logic gates.	**12**
4	**[Course Objective(s) No.: 4 & 5]** **Office Automation Tools Word Processing:** Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge, and equation editors. **Excel/Access Power Point Slides:** Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.	**13**

Suggested Readings:

1. Norton, P., *Introduction to Computers*, Mc-Graw-Hill, 2017.

2. Raja, Raman V., *Fundamental of Computers*, Prentice Hall of India, 2014

3. Sinha, P.K. and Sinha, P., *Computer fundamentals*, BPB Publications, 2010.

4. Vermaat, M.E., *Discovering Computers & Microsoft Office 2013: A Fundamental Combined Approach*, Cengage Learning, 2013.

<table>
<tr><td>Scheme Version: 2025- Onwards</td><td colspan="4">Course Name:
C Programming</td><td colspan="2">Course Code:
CST120MD40</td></tr>
<tr><td rowspan="2">Programme: P.G./U.G. (Multi-Disciplinary Course)</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td><td>Total Hours: 48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The course is designed to provide knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future. Student will learn the fundamental programming concepts and methodologies.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Learn the basic concepts of programs connecting decision structures, loops and functions.
CO2 Understand the difference between call by value and call by address.
CO3 Apply the dynamic behaviour of memory by the use of pointers.
CO4 Analyse the arrays and difference between structure and union.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:

Maximum Marks = 70 Time: 3 Hours

Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
</table>

1	**[Course Objective(s) No.: 1]** **Elements of C:** character set identifier and keywords, data type, declaration and definition. Operators: arithmetic, relational, logical, bit wise, unary, assignment and conditional operators their hierarchy arid associativity.	**12**
2	**[Course Objective(s) No.: 2]** **Control statements:** sequencing, selection, if and switch statement; repetition / loop statements: for, while, and do while loops; break, continue and goto statements.	**12**
3	**[Course Objective(s) No.: 3]** **Function:** Definition, declaration, and calling, call by value, call by reference prototype, passing parameters, actual and formal parameters, recursion.	**12**
4	**[Course Objective(s) No.: 4]** **Data Structures:** arrays, structure, structure members, access to structure members union, string, data files. Pointer: declaration, operation of pointers, array to pointers, pointers to arrays.	**12**

Suggested Readings:

1. Gottfried, B.S., Programming with C., McGraw Hill Education, 2018.
2. Hanly, J. R., Koffman, E.B. , Problem Solving and Program Design in C, 8th edition., Pearson Publications, 2015.
3. Kanetkar, Y., Let Us C, 16th Edition, BPB Publication, 2017.
4. Kernighan, B.W., and Ritchie, D.M., *The C Programming Language*, Prentice Hall, 1988.

<table>
<tr><td>Scheme Version:
2025-onwards</td><td colspan="4">Course Name:
Python Programming</td><td colspan="2">Course Code:
CST130MD40</td></tr>
<tr><td rowspan="2">Programme:
P.G./U.G. (Multi-Disciplinary Course)</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours:
48(L) + 32(P) = 80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Python Programming course generally aims to teach individuals how to write, debug, and execute Python programs, covering foundational concepts like data types, control structures, functions, and object-oriented programming. It also often includes topics like file handling, data structures, and working with external libraries.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1: Demonstrate proficiency in writing and executing Python programs using basic syntax, variables, operators, and control structures for problem-solving and logic development.
CO2: Develop modular programs using functions and effectively manipulate core data structures such as strings, lists, tuples, dictionaries, and sets.
CO3: Apply file handling and exception management techniques to build robust programs capable of reading from and writing to files in various formats.
CO4: Integrate standard and external Python libraries to create functional applications that utilize modules, perform basic data analysis, and visualize data using tools like NumPy, Matplotlib, and Pandas.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to Python & Programming Fundamentals:** History and Features of Python, Python Installation and IDEs (IDLE, VS Code, Jupyter), Writing and Executing Python Scripts, Python Syntax, Keywords, Variables, Data Types, Operators (Arithmetic, Relational, Logical, Assignment, Bitwise), Type Conversion, Input/Output Functions, Control Flow: if, if-else, if-elif-else, Looping: for, while, break, continue, pass, Basic Problem Solving and Debugging	12
2	**[Course Objective(s) No.: 2]** **Functions:** Defining, Calling, Arguments, Return Values, Scope of Variables (Local, Global), lambda functions, String Manipulation: indexing, slicing, methods **List:** creation, indexing, slicing, methods, nesting **Tuple:** characteristics, creation, methods, List vs Tuple, Iterating through strings, lists, and tuples	12
3	**[Course Objective(s) No.: 3]** **Dictionaries, Sets, File Handling, and Exception Handling:** Dictionary: creation, accessing, updating, methods Sets: characteristics, operations, methods File I/O: open(), reading/writing files, with statement Exception Handling: try, except, finally, raise Working with different file formats (.txt, .csv basics)	12
4	**[Course Objective(s) No.: 4]** **Modules, and Intro to Libraries:** Modules and Packages Standard Libraries: math, random, datetime Intro to External Libraries: Numpy, Matplotlib, Pandas, Writing Simple Programs Combining All Concepts	12

Suggested Readings:

1. Mark Lutz, Learning Python, O'Reilly, 6th Ed., 2025.
2. John Zelle, Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates, 3rd Ed., 2019.
3. Al Sweigart, Automate the Boring Stuff with Python, No Starch Press, 3rd Ed., 2025.
4. Eric Matthes, Python Crash Course, No Starch Press, 3rd Ed., 2023.

<table>
<tr><td>Scheme Version:
2025-onwards</td><td colspan="4">Course Name:
R-Programming</td><td colspan="2">Course Code:
CST140MD40</td></tr>
<tr><td rowspan="2">Programme:
P.G./U.G. (Multi-Disciplinary Course)</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 5</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4.0</td><td>Total Hours: 48(L) + 32(P) =80</td></tr>
<tr><td>Course Objectives</td><td colspan="6">R-Programming course aims to equip learners with the skills to manipulate data, perform statistical analyses, and create visualizations using the R language. It covers fundamental R concepts, data manipulation techniques, statistical modeling, and data visualization using libraries like dplyr and ggplot2. The ultimate goal is to enable learners to analyze data, draw meaningful conclusions, and present their findings effectively.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1: Apply fundamental R programming concepts, including variables, data types, control structures, loops, and functions, to write and execute scripts for data processing.
CO2: Manipulate and manage various R data structures such as vectors, lists, matrices, and data frames, and perform data import/export and transformation using packages like dplyr.
CO3: Perform descriptive statistical analysis and create effective data visualizations using base R plotting functions and ggplot2 to explore and present data insights.
CO4: Implement statistical methods and regression models, including hypothesis testing and probability distributions, to analyze and interpret real-world datasets.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
</table>

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to R and Programming Basic:** Introduction to R: Features and Applications, Installing R and RStudio IDE, Basic Syntax and R Console, Variables, Data Types, and Operators, Control Structures: if, else, ifelse, switch. Loops: for, while, repeat, Loop control (break, next) Functions: Built-in and User-defined, Scope of Variables Vectorized Operations and Vector Arithmetic	12
2	**[Course Objective(s) No.: 2]** **Data Structures and Data Handling in R**: Vectors, Lists, Matrices, Arrays, Data Frames, Factors, Indexing and Subsetting. Data Import and Export: Reading/writing .csv, .txt, Excel, JSON, readr, readxl, jsonlite, Data Manipulation using dplyr: select, filter, mutate, arrange, summarize, group by, Handling Missing Values	12
3	**[Course Objective(s) No.: 3]** **Data Visualization and Descriptive Statistics:** Descriptive Statistics: Mean, Median, Mode, SD, Variance, IQR Base R Plotting: plot(), hist(), barplot(), boxplot() Advanced Plotting with ggplot2, Customizing Plots (themes, colors, labels) Correlation and Covariance, Introduction to Data Exploration Techniques	12
4	**[Course Objective(s) No.: 4]** **Statistical Analysis and Working with Packages:** Probability Distributions: Normal, Binomial, Poisson Hypothesis Testing: t-test, Chi-square test, ANOVA Linear Regression: Simple and Multiple Logistic Regression (intro level)	12

Suggested Readings:

1. Hadley Wickham & Garrett Grolemund, R for Data Science, O'Reilly, 2nd Ed., 2023.
2. Norman Matloff, The Art of R Programming, No Starch Press, 1st Ed., 2011.
3. Andy Field, Jeremy Miles, and Zoë Field, Discovering Statistics Using R, Sage, 2022.
4. Max Kuhn and Kjell Johnson, Applied Predictive Modeling, Springer, 1st Ed., 2013.

<table>
<tr><td>Scheme Version:
2025-
Onwards</td><td colspan="4">Course Name:

Internet Fundamentals</td><td colspan="2">Course Code:

CST150MD40</td></tr>
<tr><td rowspan="2">Programme: P.G./U.G. (Multi-Disciplinary Course)</td><td rowspan="2">Total Marks: 100

CIE: 30

TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+16(T) =64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course aims to introduce the building blocks of the internet and to provide the necessary skills to utilize the internet efficiently.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Describe how the Internet works.
CO2 Understand the connections that need to be made in order to access the internet.
CO3 Demonstrate internet tools technologies including current web-based applications, e-mail, and social networking tools and apply them to solve problems.
CO4 Analyse the privacy & security protocols involved in the internet communication.
CO5 Evaluation of the internet security and document security.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are required to attempt any four sub-pats, with each carrying 3.5 marks.
3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.</td></tr>
<tr><td>Unit No.</td><td colspan="5">Content of Each Unit</td><td>Hours of Each Unit</td></tr>
<tr><td>1</td><td colspan="5">[Course Objective(s) No.: 1]

Electronic Mail: Introduction, advantages and disadvantages, Use rids, Pass words, e-mail addresses, message components, message composition, mailer features, E-mail internal workings, E- mail management, Mime types, Newsgroups, mailing lists, chat rooms.</td><td>11</td></tr>
<tr><td>2</td><td colspan="5">[Course Objective(s) No.: 2]</td><td>12</td></tr>
</table>

	The Internet: Introduction to networks and internet, history, TCP/IP Model, Working of Internet, Internet Congestion, Modes of Connecting to Internet, Internet Service Providers (ISPs), Internet addressing, Comparison of IPv4 and IPv6.	
3	**[Course Objective(s) No.: 3]** **Languages and Servers**: Basic and advanced HTML, XML basics. Introduction to Web Servers: PWS, IIS, Apache; Microsoft Personal Web Server. Accessing & using these servers.	**12**
4	**[Course Objective(s) No.: 4 & 5]** **Privacy and Security Topics**: Introduction, Encryption schemes: RSA, DES, Secure Web document, Digital Signatures, Firewalls.	**13**

Suggested Readings:

1. Castro, E., *HTML for the World Wide Web with XHTML and CSS: Visual QuickStart Guide*, Peachpit Press 2006.

2. Comer, D.E. and Droms, R.E., *Computer Networks and Internets,* Prentice-Hall, Inc., 2003.

3. Deitel, H.M., Deitel, P.J. and Nieto, T.R., *Internet & World Wide Web How to Program*, Pearson Education, 2011.

4. Gralla, P., *How the Internet Works*, QUE Publication, 2006

<table>
<tr><td>Scheme Version:
2025-onwards</td><td colspan="5">Course Name:
Management Information System & E-Commerce</td><td colspan="2">Course Code:
CST160MD40</td></tr>
<tr><td rowspan="2">Programme:
P.G./U.G.
(Multi-Disciplinary Course)</td><td rowspan="2">Total Marks: 100
CIE: 30
TEE: 70</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Contact Hours per Week: 4</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4.0</td><td>Total Hours: 48(L)+16(T) =64</td></tr>
<tr><td>Course Objectives</td><td colspan="6">This course focuses on principles of e-commerce from a business perspective, providing an overview of business and technology topics, business models, virtual value chains and social innovation and marketing strategies. In addition, some of the major issues associated with e- commerce security, privacy, intellectual property rights, authentication, encryption, acceptable use policies, and legal liabilities will be explored. Students will build their own web presence and market it using an online platform</td></tr>
<tr><td>Course Outcomes:</td><td colspan="6">Upon successful completion of the course students will be able to:
CO1 Identify the basic concept of relationship between the digital firm, electronic commerce, electronic business and internet technology.
CO2 Understand the relationship between organizations, information systems and business processes, including the processes for customer relationship management and supply chain management.
CO3 Demonstrate an understanding of the foundations and importance of E-commerce and apply them to solve problems.
CO4 Analyse the estimate the effect of changing technology on traditional business models and strategy.
CO5 Evaluation of analyzed problems of business models and strategies.</td></tr>
<tr><td colspan="7">COURSE SYLLABUS</td></tr>
<tr><td colspan="7">Instructions for the paper-setter:
Maximum Marks = 70 Time: 3 Hours
Weightage per Unit = 14 marks
1. Question Paper will consist of five questions.
2. Question No. 1 will cover the entire syllabus and will consist of seven sub-parts. Students are</td></tr>
</table>

required to attempt any four sub-pats, with each carrying 3.5 marks.

3. Questions 2 to 5 will be set from all four units of the syllabus, with one question from each unit. Each question will consist of three sub-parts, out of which students must attempt any two. Each sub-part will carry 7 marks.

Unit No.	Content of Each Unit	Hours of Each Unit
1	**[Course Objective(s) No.: 1]** **Introduction to the MIS concept [Course Outcome (s): CO1]-** Definition, Role of the MIS, Impact of MIS, MIS and the user, Management as a control system, MIS support to the management, Management effectiveness and MIS, Organization as a system. MIS: organization effectiveness. **Decision Making and DSS-** Decision making concepts, decision-making process, decision- making by analytical modelling, Behavioral concepts in decision making, organizational decision-making, Decision structure, DSS components, Management reporting alternatives.	12
2	**[Course Objective(s) No.: 2]** **Enterprise Business System:** Introduction, cross-functional enterprise applications, real- world case, Functional business system, Introduction, marketing systems, sales force automation, CIM, HRM, Customer relationship management, ERP, Supply chain management. **Client-Server Architecture and E-business Technology:** Client-server architecture, implementation strategies, Introduction to E-business, the model of E-business, Internet and World Wide Web, Intranet/Extranet, Electronic, Impact of Web on Strategic management, MIS in Web environment.	12
3	**[Course Objective(s) No.: 3]** **Introduction to E-commerce:** E-commerce Business Models and Concepts, Ecommerce Infrastructure: The Internet and World Wide Web, Web design, JavaScript Internet Information Server (IIS);	12

	Personal Web Server **E-Commerce Techniques and Issues-** Introduction to Active Server Pages, Building an E-Commerce Web Site, E-Commerce Payment Systems, E- Commerce Marketing Techniques, Building product catalogue, Search Product catalogue, Web Spider and search agent, Ethical, Social and Political Issues in ECommerce	
4	**[Course Objective(s) No.: 4 & 5]** **Internet Communication:** Transaction Systems, Shopping Carts, XML, E-Commerce Applications: Business-to- Consumer(B2C), Consumer-to-Consumer (C2C), Business- to- Business (B2B), Digital Government, Marketplaces, and Communities, Security and Encryption, Web Security.	**12**

Suggested Readings:

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., *Introduction to Algorithms,* MIT Press, 2010.

2. Goodrich, M.T., Tamassia, R. and Mount, D.M., *Data Structures and Algorithms in C++*, John Wiley & Sons, 2016.

3. Langsam, Y., Augenstein, M. and Tenenbaum, A.M., *Data Structures using C and C++,* Prentice Hall, 2015.

4. Lipschutz, S., *Schaum's Outline of Theory and Problems of Data Structures*, McGraw-Hill, 2014

12. Teaching-Learning Process

- Lectures
- Discussions
- Simulations
- Role Playing
- Participative Learning
- Interactive Sessions
- Seminars
- Research-based Learning/Dissertation or Project Work
- Technology-embedded Learning

13 Implementation of Blended Learning

Blended Learning is a pedagogical approach that combines face to-face classroom methods with computer-mediated activities in the process of teaching and learning. It implies nice blend of face-to-face and online activities to make the learning processes more interesting and engaging. It focuses on integration of traditional classroom activities and innovative ICT-enabled strategies. It emphasizes student-centric learning environment where the teacher is the facilitator for productive and measurable learning outcomes. It optimizes and compliments the face to face learning, giving ample freedom and flexibility to the students and teachers to access and explore the wide range of open-access sources such as video lectures, podcasts, recordings and articles through digital platforms. It gives freedom and autonomy to the teachers in selection of appropriate digital platforms, resources and time-slots to complement and supplement face to face learning. The Blended Learning doesn't undermine the role of the teacher, rather it gives him/her an opportunity to explore the unexplored in accordance with the requirements of the curriculum.

Key features of Blended Learning

- **Student-Centric Pedagogical Approach** focusing on flexibility in timing, quality content, needs and interests of students and freedom to study through the mode of his/her choice;
- Freedom to Select variety of mediums and techniques;
- Increased student engagement in learning;
- Enhanced teacher and student interaction;
- Improved student learning outcomes;
- More flexible teaching and learning environment;
- More responsive for self and continuous learning;
- Better opportunities for experiential learning;
- Increased learning skills;
- Greater access to information, improved satisfaction and learning outcomes.

Note: Resolution no (c) as per minutes circulated by VC office**:** It was resolved that Blended Learning with 40% component of online teaching and 60% face to face classes for each programme, be adopted.

14. Assessment and Evaluation

- Continuous Comprehensive Evaluation at regular after achievement of each Course-level learning outcome
- Formative Assessment on the basis of activities of a learner throughout the programme instead of one-time assessment
- Oral Examinations to test presentation and communication skills
- Open Book Examination for better understanding and application of the knowledge acquired
- Group Examinations on Problem solving exercises
- Seminar Presentations
- Review of Literature
- Collaborative Assignments

15. Keywords

a. LOCF
b. NEP-2020
c. Blended Learning
d. Face to face (F to F) Learning
e. Programme Outcomes
f. Programme Specific Outcomes
g. Course-level Learning Outcomes
h. Postgraduate Attributes
i. Learning Outcome Index
j. Formative Assessment and Evaluation
k. Comprehensive and Continuous Evaluation

16. References

a. National Education Policy-2020. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

b. The draft subject specific LOCF templates available on UGC website. https://www.ugc.ac.in/ugc_notices.aspx?id=MjY5OQ

c. Draft Blended Mode of Teaching and Learning: Concept Note available on UGC website. https://www.ugc.ac.in/pdfnews/6100340_Concept-Note-Blended-Mode-of-Teaching-and-Learning.pdf

17. Appendices

- **Syllabi & Scheme**