SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA, 682013

Syllabus of Courses

Under the discipline

Computer Science

(For Undergraduate (Honours) Degree Programmes)

Introduced from 2024-25 admissions onwards

Prepared by

Board of Studies in Computer Science

Sacred Heart College, Thevara, Kochi.

BOARD OF STUDIES IN COMPUTER SCIENCE
SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI, KERALA

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1. INTRODUCTION

The National Education Policy (NEP) 2020 envisages the revision of the Choice Based Credit System (CBCS) for instilling innovation and flexibility. It emphasizes on promoting interdisciplinary studies, introducing new subjects, and providing flexibility in courses and fresh opportunities for students. It also envisages setting up of facilitative norms for issues, such as credit transfer, equivalence etc., and a criterion-based grading system that assesses student achievement based on the learning goals for each programme.

The NEP document suggests several transformative initiatives in higher education. These include:

- Introduction of holistic and multidisciplinary undergraduate education that would help develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, ethical and moral - in an integrated manner; soft skills, such as complex problem solving, critical thinking, creative thinking, communication skills; and rigorous specialization in a chosen field (s) of learning.
- Adoption of flexible curricular structures in order to enable creative combinations of disciplinary areas for study in multidisciplinary contexts in addition to rigorous specialization in a subject.
- Undergraduate degree programmes of either 3 or 4-year duration.
- The students are getting a chance to determine his/her own semester-wise academic load and will be allowed to learn at his/her pace, to the extent possible.
- Increase in the number of choices of courses available to students and the students are getting an opportunity to choose the courses of their interest from all disciplines.
- Multidisciplinary and holistic education with emphasizes on research, skill development and higher order thinking,
- Promotion of innovation and employability of the student.
- Flexibility for the students to move from one institution to another as per their choice.
- Flexibility to switch to alternative modes of learning (offline, ODL, and online learning, and hybrid modes of learning).

Outcome Based Education (OBE)

Undergraduate courses in Computer Science follow the Outcome-based Education (OBE) framework. OBE is a system where all the parts and aspects of education are focused on the outcomes of the course. The students take up courses with a certain goal of developing skills or gaining knowledge and they have to complete the goal by end of the course. Outcome-based education affirms teachers as facilitators, rather than lecturers. In this model, teachers guide the students and encourage them to develop their knowledge and skills. The undergraduate courses at the Department of Computer Science Sacred Heart College (Autonomous), Thevara provides a learning approach in which students develop analytical ability and critical thinking and research acumen over different situations.

Programme Outcomes:

The Undergraduate Programme Outcomes (POs) are as follows:

PO 1: Critical thinking and Analytical reasoning

- Critical thinking guides the assessment and judgment of information, while analytical reasoning involves specific methods for analysis and conclusion drawing. It includes the ability to assess evidence, identify assumptions, formulate coherent arguments, understand complex relationships, and evaluate practices and theories critically. Additionally, critical sensibility involves self-awareness and reflection on personal and societal experiences.

PO 2: Scientific reasoning and Problem solving

- Capacity to interpret and draw conclusions from data, critically evaluate ideas and evidence with an open-minded perspective; ability to apply learned competencies to solve unfamiliar problems and apply knowledge to real-life situations, avoiding mere replication of curriculum content.

PO 3: Effective communication and leadership skill

- Proficiency in expressing thoughts verbally and non-verbally, utilizing appropriate communication media. Confidently sharing ideas, active listening, analytical reading and writing and presenting complex information clearly to diverse groups. Effective teamwork and leadership skills, including setting direction, inspiring vision, building and motivating teams, and guiding them efficiently towards common goals.

PO 4: Social consciousness and responsible citizenship

- Social consciousness involves an empathetic and informed perspective, extending beyond personal concerns to embrace a responsibility for the collective good in nation-building. It includes reflecting on the impact of research on conventional practices and a clear understanding of societal needs for inclusive and sustainable development. Responsible citizens contribute positively through civic engagement, environmental stewardship, and a commitment to social justice, abiding by laws and working for the advancement of society.

PO 5: Equity, Inclusiveness and Sustainability

- Promoting equity, inclusiveness, sustainability, and diversity appreciation. Developing ethical and moral reasoning with values of unity, secularism, and national integration for dignified citizenship. Understanding and appreciating diversity, managing differences, and using an inclusive approach. Emphasizing creating environments

where diverse individuals feel valued, addressing present needs without compromising future generations' ability to meet their own needs, considering environmental, economic, and social factors.

PO 6: Moral and Ethical Reasoning

- Possessing the capacity to embody moral and ethical values in personal conduct, articulating positions and arguments on ethical matters from diverse perspectives, and consistently applying ethical practices in all endeavours. Proficient in recognizing and addressing ethical issues pertinent to one's work, steadfastly steering clear of any unethical behaviour.

PO 7: Networking and Collaboration

- Cultivating networking skills in education entails establishing meaningful professional connections and relationships among educators, administrators, and stakeholders. It also involves fostering cooperative efforts among individuals, institutions, and research organizations within the educational realm. These practices are indispensable for nurturing a supportive, innovative, and dynamic learning environment.

PO 8: Lifelong Learning

- Cultivating the ability to continually acquire knowledge and skills, including the art of "learning how to learn," becomes paramount for lifelong learning. This self-paced and self-directed approach serves personal development, aligns with economic, social, and cultural objectives, and facilitates adaptation to evolving workplace demands through skill development and reskilling. It equips individuals with competencies and insights, allowing them to adeptly respond to society's changing landscape and enhance their overall quality of life. Lifelong learning extends beyond formal education, embracing diverse informal and non-traditional learning experiences.

About the Programme

A student admitted to the programme will be awarded degree as per the regulations given in Chapter 2. The proposed pathway is BSc (Honours) with Computer Applications as major, Mathematics and Statistics as preferred minors. The department also offers minor courses in Computer Applications. The programme includes internship and a project work.

On successful completion of BSc Computer Applications, students can join Masters Programmes in Data Science, Artificial Intelligence, Data Analytics, MCA, Computer Science, IT, and seek employment opportunities in Small, Medium and Large Professional Services, Enterprise Application Product and Service Companies, e-Commerce, m-Commerce companies, Internet companies, Data Analyst, Data Scientist, and Data Engineer.

2. REGULATIONS FOR UNDERGRADUATE (HONOURS) DEGREE PROGRAMMES

PREAMBLE

Sacred Heart College (Autonomous), Thevara, Kochi is a grant-in-aid private college affiliated to Mahatma Gandhi University, Kottayam, Kerala. The College was established in 1944 as a higher educational institute for men on the basis of minority rights. It started admitting girls in 1975 and currently serves all sections of the society without any discrimination of caste or creed.

The College was granted Autonomous Status by the University Grants Commission (UGC) in 2014.

Vision and Mission of the Institution

The vision of the College aims at the formation of holistic individuals who would champion the cause of justice, love, truth and peace. To this effect, Sacred Heart College envisions the **"Fashioning of an enlightened society founded on a relentless pursuit of excellence, a secular outlook on life, a thirst for moral values as well as an unflinching faith in God."** It seeks the creation of a world, guided by divine wisdom, governed by moral principles, inclusive by secular outlook and united by the principle of equity.

The Mission of the Institution is to provide an environment that

- **facilitates the holistic development of the individual**
- **enables the students to play a vital role in the nation-building process and contribute to the progress of humanity**
- **disseminates knowledge even beyond the academia**
- **instils in the students a feel for the frontier disciplines, and**
- **cultivates a concern for the environment**

by setting lofty standards in the ever-evolving teacher-learner interface.

Framing of the Regulations

As part of the implementation of the National Education Policy 2020 (NEP 2020), the University Grants Commission (UGC) has issued the Curriculum and Credit Framework for Undergraduate Programmes 2023 (CCFUP) which would provide a flexible choice-based credit system, multidisciplinary approach, multiple entry and exit options, and establish three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).

The Kerala Higher Education Reforms Commission has recommended a comprehensive reform in the undergraduate curriculum for the 2023-24 academic year, adopting 4-year undergraduate programs to bring Kerala's undergraduate education at par with well acclaimed universities across the globe.

The Kerala State Curriculum Committee for Higher Education has been constituted, and have proposed a model Kerala State Higher Education Curriculum Framework (KSHECF) for Undergraduate Education.

Further, an Academic Committee and various sub committees were constituted for the implementation of the Regulations. The Academic Committee submitted the draft regulations on 15-03-2024, namely**: THE SACRED HEART COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SHC-UGP (Honours)}** under the New Curriculum and Credit Framework, 2024.

REGULATIONS

Short Title and Commencement

i. These Regulations may be called THE SACRED HEART COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SHC-UGP (Honours)} under the New Curriculum and Credit Framework 2024.
ii. These Regulations will come into effect from the academic year 2024-2025 and will have prospective effects.

Scope and Application

iii. These Regulations shall apply to all Undergraduate programmes under various Faculties conducted by THE SACRED HEART COLLEGE (AUTONOMOUS) for the admissions commencing in the academic year 2024-2025.
iv. Every programme conducted under the SHC-UGP shall be monitored by an SHC-UGP Academic Committee comprising members nominated by the Principal.

Definitions

Unless used in a context otherwise specified,

i. College means THE SACRED HEART COLLEGE (Autonomous), a grant-in-aid private college affiliated to Mahatma Gandhi University, Kottayam, Kerala.
ii. 'University' means the MAHATMA GANDHI University which is the affiliating University of Sacred Heart College (Autonomous).
iii. FYUGP means Four Year Undergraduate Programme.
iv. Academic Year: Two consecutive (one odd and one even) semesters followed by a vacation in one academic year.
v. Academic Coordinator/Nodal Officer: Academic Coordinator/Nodal Officer is a faculty nominated by the college council to co-ordinate the effective conduct of the FYUGP including Continuous Comprehensive Assessment (CCA) undertaken by various departments within the college. She/ he/ they shall be the convenor for the College level Academic Committee.
vi. Academic Week: A unit of five working days in which the distribution of work is organized, with at least five contact hours of one-hour duration on each day.
vii. Academic Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. It is defined both in terms of student efforts and teacher's efforts. A course which includes one hour of lecture or tutorial or minimum 2 hours of lab work/ practical work/ field work per week is given one credit hour. Accordingly, one credit is

equivalent to one hour of lecture or tutorial or two hours of lab work/ practical work/ field work/ practicum and learner engagement in terms of course related activities (such as seminars preparation, submitting assignments, group discussion, recognized club-related activities etc.) per week. Generally, a one credit course in a semester should be designed for 15 hours Lecture/ tutorials or 30 hours of practical/ field work/ practicum and 30 hours learner engagement.

viii. Academic Bank of Credits (ABC): An academic service mechanism as a digital/ virtual entity established and managed by Government of India to facilitate the learner to become its academic account holder and facilitating seamless learner mobility, between or within degree-granting Higher Education Institutions (HEIs) through a formal system of credit recognition, credit accumulation, credit transfers and credit redemption to promote distributed and flexible process of teaching and learning. This will facilitate the learner to choose their own learning path to attain a Degree/ Diploma/ Certificate, working on the principle of multiple entry and exit, keeping to the doctrine of anytime, anywhere, and any level of learning.

ix. Credit Accumulation: The facility created by ABC in the Academic Credit Bank Account (ABA) opened by learners across the country in order to transfer and consolidate the credits earned by them by undergoing courses in any of the eligible HEIs.

x. Credit Recognition: The credits earned through eligible/ partnering HEIs and transferred directly to the ABC by the HEIs concerned.

xi. Credit Redemption: The process of commuting the accrued credits in the ABC of the learner for the purpose of fulfilling the credits requirements for the award of various degrees. Total credits necessary to fulfil the criteria to get a degree shall be debited and deleted from the account concerned upon collecting a degree by the learner.

xii. Credit Transfer: The mechanism by which the eligible HEIs registered with ABC are able to receive or provide prescribed credits to individual's registered with ABA in adherence to the UGC credit norms for the course(s) registered by the learner in any HEIs within India.

xiii. Credit Cap: Maximum number of credits that a student can take per semester, which is restricted to 30.

xiv. Continuous Comprehensive Assessment (CCA): The mechanism of evaluating the learner by the course faculty at the institutional level.

xv. End Semester Evaluation (ESE): The mechanism of evaluating the learner at the end of each semester.

xvi. Audit Course: a course that the learner can register without earning credits, and is not mandatory for completing the SHC-UGP. The student has the option not to take part in the CCA and ESE of the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is eligible for a pass in that course, without any credit (zero-credit).

xvii. Courses: refer to the papers which are taught and evaluated within a programme, which include lectures, tutorials, laboratory work, studio activity, field work, project work, vocational training, viva, seminars, term papers, presentations, assignments, self-study, group discussion, internship, etc., or a combination of some of these elements.

xviii. Choice Based Credit System (CBCS) means the system wherein students have the option to select courses from the prescribed list of courses.

xix. College-level Academic Committee: Is a committee constituted for the FYUGP at the college level comprising the Principal as the Chairperson, the Academic Co-ordinator/ Nodal Officer as its convenor.

xx. Academic Co-ordinator/ Nodal Officer: A senior faculty member nominated by the college council.

xxi. Course Faculty: A faculty member nominated by the Head of the Department shall be in charge of offering a particular course in a particular semester of FYUGP.

xxii. Department means any teaching department in a college offering a course of study approved by the College as per the regulations of the college and it includes a Department, Centre, or School of Teaching and Research conducted directly by the College.

xxiii. Board of Studies (BoS) means the academic body duly constituted to frame the syllabus of each department.

xxiv. Senior Faculty Advisor (SFA) is a faculty nominated by a Department Council to co-ordinate all the necessary work related to FYUGP undertaken in that department, including the continuous comprehensive assessment.

xxv. Department Council means the body of all teachers of a department in a college.

xxvi. Faculty Adviser (FA) means a teacher from the parent department nominated by the Department Council to advise students in academic matters.

xxvii. Graduate Attributes means the qualities and characteristics to be obtained by the graduates of a programme of study at the College, which include the learning outcomes related to the disciplinary areas in the chosen field of learning and generic learning outcomes. The College will specify graduate attributes for its programmes.

xxviii. Programme means the entire duration of the educational process including the evaluation leading to the award of a degree.

xxix. Programme Pathway: Combination of courses that can be chosen by a student that give options to pursue interesting and unconventional combinations of courses drawn from different disciplinary areas, like the sciences and the social sciences/ humanities. The pathways could be in terms of major- minor options with different complementary/ allied disciplines.

xxx. Regulatory Body means University Grants Commission (UGC), All India Council for Technical Education (AICTE), National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA) etc.

xxxi. Signature Courses: Signature courses are the specialized Discipline Specific Elective courses or skill-based courses designed and offered by the regular/ ad hoc/ visiting/ emeritus/ adjunct faculty member of a particular college with the prior recommendation of the BoS and the approval of Academic Council of the College.

xxxii. Letter Grade or simply 'Grade' in a course is a letter symbol (O, A+, A, B+, B, C, P, F, and Ab). Grade shall mean the prescribed alphabetical grade awarded to a student based on their performance in various examinations. The Letter grade that corresponds to a range of CGPA.

xxxiii. Grade Point: Each letter grade is assigned a 'Grade point' (G) which is an integer indicating the numerical equivalent of the broad level of performance of a student in each course. Grade Point means point given to a letter grade on 10-point scale.

xxxiv. Semester Grade Point Average (SGPA) is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a

semester by the total number of credits in that semester. SGPA shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxxv. Credit Point (P) of a course is the value obtained by multiplying the grade point (G) by the credit (C) of the course: P = G x C

xxxvi. Cumulative Grade Point Average (CGPA) is the value obtained by dividing the sum of credit points in all the semesters earned by the student for the entire programme by the total number of credits in the entire programme and shall be rounded off to two decimal places.

xxxvii. Grade Card means the printed record of students' performance, awarded to them.

xxxviii. Words and expressions used and not defined in this regulation, but defined in the Mahatma Gandhi University Act and Statutes, being the Act and Statues of Sacred Heart College (Autonomous)'s affiliating University shall have the meaning assigned to them in the Act and Statutes.

Features and Objectives of SHC-UGP

The features and objectives of the SHC-UGP shall be:

v. The features, meaning, and purpose of FYUGP shall be as stipulated by the UGC and as adapted by the Kerala State Higher Education Curriculum Framework (KSHECF) for undergraduate education.

vi. The practice of lateral entry of students to various semesters exists, but an exit with a Degree shall be awarded only upon successful completion of 133 credits as per the conditions stipulated in this regulation.

vii. FYUGP shall have three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).

viii. Students who choose to exit after 3 years shall be awarded UG Degree in their respective Discipline/ Disciplines after the successful completion of the required minimum Courses with 133 credits.

ix. A 4-year UG Degree (Honours) in the Discipline/ Disciplines shall be awarded to those who complete the FYUGP with a specific number of Courses with 177 credits including 8 credits from a graduate project/ dissertation in their major discipline.

x. Students who acquire minimum 75% in their graduation (upto 6th semester) are eligible for Honours with Research Programme. However if necessary, College may conduct screening test for the honours with research programme in accordance with College Regulations from time to time.

xi. 4-year UG Degree (Honours with Research): Students who aspire to pursue research as a career may opt for 4-year UG Degree Honours with Research stream under FYUGP with a specific number of Courses with 177 credits including 12 credits from a research project in their major discipline.

xii. The recognized research departments or departments with at least two faculty members having PhD shall offer the Honours with Research programme. Minimum 2 students (mentees) should be allotted to a faculty member (Mentor).

xiii. Students who have chosen the honours with research stream shall do their entire fourth year under the mentorship of a mentor.

xiv. The mentor shall prescribe suitable advanced level/capstone level courses for a minimum of 20 credits to be taken within the institutions along with the courses on research methodology, research ethics, and research topic-specific courses

for a minimum of 12 credits which may be obtained either within the institution or from other recognized institutions, including online and blended modes.

xv. Students who have opted for the honours with research should successfully complete a research project under the guidance of the mentor and should submit a research report for evaluation. They need to defend successfully the research project to obtain 12 credits under a faculty member of the College. The research shall be in the Major/ allied discipline.

xvi. The research outcomes of their project work may be published in peer-reviewed journals or presented at conferences or seminars or patented.

xvii. The proposed FYUGP curriculum comprises Three Broad Parts: a) Foundation Components, b) Discipline Specific Pathway components (Major/ Minor), and c) Discipline Specific Capstone Components.

xviii. The Foundation component of the FYUGP shall consist of a Set of General Foundation Courses and a Set of Discipline Specific Foundation Courses.

xix. General Foundation Courses shall be grouped into 4 major baskets as Ability Enhancement Courses (AEC), Skill Enhancement Courses (SEC), Value Addition Courses (VAC), and Multi-Disciplinary Courses (MDC).

xx. Ability Enhancement Courses shall be designed specifically to achieve competency in English, other languages as per the student's choice with special emphasis on language and communication skills.

xxi. English or other language courses shall be designed to enable the students to acquire and demonstrate the core linguistic skills, including critical reading, academic and expository writing skills as well as the cultural and intellectual heritage of the language chosen. Separate courses will be designed for Science, Humanities and Commerce streams.

xxii. Multi-Disciplinary Courses (MDC) shall be so designed as to enable the students to broaden their intellectual experience by understanding the conceptual foundations of Science, Social Sciences, Humanities, and Liberal Arts. Students shall not be eligible to take the MDC in the same discipline that they have studied during their +2. Third semester MDC can be Kerala specific content.

xxiii. Skill Enhancement Courses (SEC) shall be designed to enhance 21st century workplace skills such as creativity, critical thinking, communication, and collaboration.

xxiv. Discipline Specific Courses shall include Discipline Specific Pathway Courses, both Major and Minor streams, enabling students to gain basic knowledge in the chosen discipline.

xxv. Discipline Specific Foundation Courses shall focus on foundational theories, concepts, perspectives, principles, methods, and critical thinking essential for taking up advanced/ Capstone Courses. Practical courses shall be included in discipline specific foundation courses.

xxvi. The curriculum of the SEC should be designed in a manner that at the end of year- 1, year-2, year-3, and year-4 students are able to meet the level descriptors for levels 5, 6, 7, and 8 of the UGC Guidelines on National Skills Qualifications Framework (NSQF). The detailed descriptors of the NSQF levels is provided as **Appendix I** below.

xxvii. Value Addition Courses (VAC) shall be so designed as to empower the students with personality development, perspective building, and self-awareness.

xxviii. Discipline Specific Pathway Components (Major/ Minor) shall provide the students with an opportunity to pursue in-depth study of a particular subject or

discipline and develop competency in that chosen area, which includes Discipline Specific Core (DSC) courses and Discipline Specific Elective (DSE) courses as Major and Minor courses.

xxix. Major components consist of three types: Discipline Specific Core or the Discipline Specific Elective Courses, and the research /laboratory/ fieldwork.

xxx. Minor Courses can be selected from any discipline that may supplement or complement the Major Courses.

xxxi. Students who complete a sufficient number of Courses in a discipline or an interdisciplinary area of study other than their chosen Major shall qualify for a Minor in that discipline or in a chosen interdisciplinary area of study.

xxxii. Major Components shall be the main focus of study. By selecting a Major, the student shall be provided with an opportunity to pursue an in-depth study of a particular discipline.

xxxiii. Each Board of Studies (BoS) shall identify specific Courses or baskets of Courses towards Minor Course credits. Students shall have the option to choose Courses from disciplinary/ interdisciplinary minors and skill-based courses related to a chosen programme.

xxxiv. Students can opt for a change of Major at the end of the second semester to any Minor discipline studied among the foundation level courses. Students also can opt for a change of Major at the end of the second semester to any MDC.

xxxv. Students should opt their 5th and 6th semester VAC and SEC from their Major disciplines only.

xxxvi. Course cum Credits Certificate: After the successful completion of a semester as proof for re-entry to another institution this certificate is essential. This will help the learner for preserving the credits in the Academic Bank of Credits.

xxxvii. The Advanced Level/ Capstone Level Courses shall be designed in such a manner as to enable students to demonstrate their cumulative knowledge in their main field of study, which shall include advanced thematic specialization or internships or community engagement or services, vocational or professional training, or other kinds of work experience.

xxxviii. Advanced/ Capstone level Major Specialization shall include Courses focused on a specific area of study attached to a specific Major, which could be an Elective Course. They shall include research methodology as well.

xxxix. The student has the option to register for and attend a course without taking part in the CCA and ESE of that course. Such a course is called the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is/are eligible for a pass in that course, without any credit (zero-credit). The Audit Course will be recorded in the final grade card of the student.

xl. All students shall undergo Summer Internship or Apprenticeship in a Firm, Industry or Organization; or Training in labs with faculty and researchers or other Higher Education Institutions (HEIs) or Research Institutions. The College will adhere to the guidelines on internship published by the University.

xli. Students will be provided the opportunities for internships with local industries, business organizations, agriculture, health and allied sectors, Local Government institutions (such as panchayats, municipalities), State Planning Board, State Councils/ Boards, Research Institutions, Research Labs, Library, elected representatives to the parliament/ state assembly/ panchayat, media organizations, artists, crafts persons etc. These opportunities will enable the students to actively engage with the practical aspects of their learning and to improve their employability.

xlii. The College will provide opportunities for field-based learning/minor projects enabling them to understand the different socio-economic and development-related issues in rural and urban settings. The College will provide the students with opportunities for Community engagement and services, exposing them to socio-economic issues to facilitate theoretical learning in real-life contexts.

xliii. Additional Credits will be awarded for those who actively participating in Social Activities, which may include participation in National Service Scheme (NSS), Sports and Games, Arts, participation in College union related activities (for respective elected/ nominated members), National Cadet Corps (NCC), adult education/ literacy initiatives, mentoring school students, and engaging in similar social service organizations that deemed appropriate to the College.

xliv. Grace marks shall be awarded to a student for meritorious achievements in co-curricular activities (in Sports/ Arts/ NSS/ NCC etc.). Such a benefit is applicable in the same academic year spreading over two semesters, in which the said meritorious achievements are earned. The Academic Council will decide from time to time the eligibility and other rules of awarding the grace marks.

xlv. Options will be made available for students to earn credit by completing quality-assured remote learning modes, including Online programmes offered on the Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) or other Online Educational Platforms approved by the competent body/university from time to time.

xlvi. Students shall be entitled to gain credits from courses offered by other recognized institutions directly as well as through distance learning.

xlvii. For the effective operation of the FYUGP, a system of flexible academic transaction timings shall be implemented for the students and teachers.

Eligibility for Admission and Reservation of Seats

i. The eligibility for admissions and reservation of seats for various FYUG Degree Programmes shall be in accordance with the norms/ rules made by the Government/ University from time to time.

ii. No student shall be eligible for admission to FYUG Degree Programmes in any of the disciplines unless he/she/they has successfully completed the examination conducted by a Board/University at the +2 level of schooling or its equivalent.

iii. Students shall be admitted and enrolled in the respective programmes solely based on the availability of the academic and physical facilities within the institution. The College shall provide all students with a brochure detailing the Courses offered by the various departments under the various Programmes and the number of seats sanctioned by the University for each Programme.

iv. During the time of admission each student may be provided with a unique higher education student ID which may be linked with the Aadhar number of the student so that this ID can be transferred if required to other higher education institutions as well.

v. The students at the end of second semester may be permitted to change their major programme of study to any course/ institution/ university across the state. Based on the availability of seats and other facilities, the students may be permitted to opt any discipline which he/she/they had studied during the first two semesters as Discipline Specific Foundation courses/ Multidisciplinary

Foundation courses. If ranking is required it will be in the order of the highest-grade points secured in the discipline to which the switching of Major is sought.

vi. Students shall be allowed to change their major programmes, if required, to a maximum of 10% of the sanctioned strength of that particular programmes depending upon the academic and infrastructural facilities available in the Institution.

vii. Depending upon the availability of academic and infrastructural facilities, the College may also admit a certain number of students who are registered for particular programmes in each semester by transfer method, if required, from other Institutions subject to conditions as may be issued by the University.

viii. A student who has already successfully completed a First-Degree Programme and is desirous of and academically capable of pursuing another First-Degree Programme may also be admitted with the prior approval of the University as per the conditions regarding programme requirements specified by the University.

ix. A Student can also be admitted for an additional major/ second major/ additional minor and on completion of the required credits he/she/they can be awarded a second major/ additional major/ minor. He/she/they may be exempted from minor pathway and general foundation course requirement.

x. The College can also enrol students in certain courses as per their choice depending upon the availability of infrastructure and other academic facilities from other recognized HEIs who are already registered for a particular programme there either through regular/ online/ distance mode irrespective of the nature of programme (Govt./ Aided/ Self- finance/ Autonomous). On successful completion of the course the credits may be transferred through the Academic Bank of Credit.

Academic Monitoring and Student Support

The academic monitoring and student support shall be in the following manner, namely

i. The College shall appoint a Senior Faculty member as Academic Co-ordinator/ Nodal officer for the smooth conduct of FYUGP.

ii. Advisory System: There shall be one Senior Faculty Advisor (SFA) for each department and one Faculty Advisor (FA) for 20 to 30 students of the class to provide advice in all relevant matters. The Head of the Department, in consultation with the SFA, shall assign FA for each student.

iii. The documents regarding all academic activities of students in a class shall be kept under the custody of the FA/ SFA.

iv. All requests/ applications from a student or parent to higher offices are to be forwarded/ recommended by FA/ SFA.

v. Students shall first approach their FA/ SFA for all kinds of advice, clarifications, and permissions on academic matters.

vi. It is the official responsibility of the institution to provide the required guidance, clarifications, and advice to the students and parents strictly based on the prevailing academic regulations.

vii. The SFA shall arrange separate or combined meetings with FA, faculty members, parents, and students as and when required and discuss the academic progress of students.

viii. The FA/ SFA shall also offer guidance and help to solve the issues on academic and non-academic matters, including personal issues of the students.

ix. Regular advisory meetings shall be convened immediately after the commencement of the semester and immediately after announcing the marks of the Continuous Comprehensive Assessment (CCA).

x. The CCA related results shall be displayed on the department notice board/ other official digital platforms of the college at least for two working days.
   a. Any concern raised by the students regarding CCA shall be looked into in the combined meetings of advisors, HOD, course faculty, and the students concerned.
   b. If the concerns are not resolved at the advisor's level, the same can be referred to the properly constituted college-level grievance redressal committees as per the existing UGC/ University/ Government norms.
   c. The Principal/ HOD shall ensure the proper redressal of the concerns raised by the students regarding CCA.
   d. If the students raise further concerns about the issue, the principal shall refer the issue to the appropriate authorities with proper documents and minutes of all the committees.

xi. The FA/ SFA shall be the custodian of the minutes and action taken reports of the advisory meetings. The SFA shall get the minutes and action taken reports of advisory meetings approved by the Head of Department and the Principal.

xii. The Principal shall inform/forward all regulations, guidelines, communications, announcements, etc. regarding student academic and other matters to the HODs/ SFA for information and timely action.

xiii. It shall be the official responsibility of the Principal to extend the required administrative and financial support to the HODs, SFAs and FAs to arrange necessary orientation programmes for students regarding student counselling, the prevailing norms, regulations, guidelines and procedures on all academic and other related matters.

xiv. An integrated educational planning and administration software will be made available by the College to manage the academic information of all students including student admissions and registration, managing students' personal and academic information, course registrations, attendance management, all process related to assessments including regular & online examinations, grading, publishing of results, supplementary examinations, LMS, stakeholders' feedback, etc.

xv. Faculty, staff, students, and parents shall be allowed to access this software system over a highly secure authenticated mechanism from within the campus.

Course Registration

i. Each department shall publish well in advance the relevant details of courses offered, such as the name, academic level, expected outcomes, time slot, and course faculty members.

ii. Students shall be allowed to visit and interact with respective faculty members during the first week of each semester, to gather more information about the courses and the availability of seats.

iii. Based on consultations and advice from the faculty adviser, each student shall complete course registration within one week from the commencement of each semester.

iv. The number of credits that a student can take in a semester is governed by the provisions in these Regulations, subject to a minimum of 16 and a maximum of 30 Credits.
v. A student can opt out of a Course or Courses registered, subject to the minimum Credit/ Course requirement, if he/she/they feels that he/she/they has registered for more Courses than he/she/they can handle, within 30 days from the commencement of the semester.
vi. The college shall publish a list of the students registered for each course including audit course, if any, along with the chosen Programmes, repeat/ reappearance courses, if any.
vii. The higher education institutions shall admit candidates not only for programmes, but also for courses.

Re-admission and Scheme Migration

i. Students who opt out before the completion of the third year shall be provided with a 'Course cum Credits Certificate' after the successful completion of a semester as proof for re-entry to another institution.
ii. Students who have successfully completed a particular programme pathway may be permitted to take an additional minor or second major.
iii. Those students who are opting for a second major are eligible for getting certain credit transfer/ credit exemption from their previous minor programs of study, subject to the prior recommendation of the BoS that those credits are relevant for the present major programme of study.

Duration of Programme, Credits, Requirements and Options

i. Students will be offered the opportunity to take breaks during the programme and resume after the break, but the total duration for completing the FYUG programme shall not exceed 7 years.
ii. Students who wish to complete the undergraduate programmes faster may do so by completing different courses equivalent to the required number of credits and fulfilling all other requirements in N-1 semesters, where N is the number of semesters in the FYUGP.
iii. Provided further that the students may complete the undergraduate programme at a slower pace, they may pursue the three years or six semester programme in 4 to 5 years (8 to 10 semesters), and four years, or eight semester programme in 5 to 6 years (10 to 12 semesters) without obtaining readmission.
iv. For students who crossed 6 semesters at a slower pace, the requirement of 16 credits per semester from the institutions where they enrolled may be relaxed.

Credit Structure

The proposed number of credits per course and the credit distribution of them for the FYUG Programmes are given below:

i. An academic year shall consist of 200 working days; one semester consists of 90 working days; and an academic year consists of two semesters.
ii. Ten working days in a semester shall be used for extracurricular activities. One semester consists of 18 weeks with 5 working days per week. In each semester, 15 days (3 weeks) should be kept aside for End Semester Evaluation (ESE) and CCA.

iii. The maximum number of available weeks for curriculum transactions should be fixed at 15 in each semester. A minimum of 5 teaching or tutorial hours could be made available for a day in a 5-day week.
iv. A course that includes one hour of lecture/ tutorial or two hours of lab work/ practical work/ field work/ practicum per week is given one credit hour.
v. One credit in a semester should be designed for 15 hours of lectures/ tutorials or 30 hours of lab work/ practical work/ field work/ practicum and 30 hours of learner engagement in terms of course-related activities such as seminar preparation, submitting assignments, etc.
vi. A one-credit seminar or internship or studio activities or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).
vii. A course can have a combination of lecture credits, tutorial credits, and practicum credits.
viii. Minimum credit for one Course should be 2 (Two), and the maximum credit should be 4 (Four).
ix. All Discipline Specific Major/ Minor Courses shall be of 4 (Four) credits.
x. For all Discipline Specific Major/ Minor Courses, there may be practical/ practicum of two or four hours per week.
xi. All Courses under the Multi-Disciplinary, Ability Enhancement, Value Addition and Skill Enhancement categories are of 3 credits.
xii. Summer Internship, Apprenticeship, Community outreach activities, etc. may require sixty hours (or as appropriate) of engagement for acquiring one credit.
xiii. A student shall be able to opt for a certain number of extra credits over and above the requirements for the award of a degree.
xiv. Maximum number of credits that a student can earn per semester shall be restricted to 30. Hence, a student shall have the option of acquiring credits to a maximum of 180 credits for 6-semester UG programmes and 240 credits for 4-year (8-semester) programmes.
xv. Each faculty member shall offer a maximum of 16 credits per semester. However those who are offering both practical and theory courses shall offer a maximum of 12-16 credits per semester.
xvi. For a four-credit theory course, 60 hours of lecture/ tutorial class shall be assured as a mandatory requirement for the completion of that course.

Course Structure of the SHC-UGP Programme

The SHC-UGP consists of the following categories of courses and the minimum credit requirements for pathway option-one shall be as follows;

Sl. No.	Categorization of Courses for all Programme	Minimum Number of Credit Required	
1.	Major	68	88
2.	Minor	24	24+12*
3.	Multi-Disciplinary Courses (MDC)	9	9
4.	Skill Enhancement Courses (SEC)	9	9
5.	Ability Enhancement Courses (AEC)	12	12
6.	Value Addition Courses (VAC)	9	9
7.	Summer Internship, field based learning etc.	2	2
8.	Research Project / Dissertation		12/8**

* The students can acquire advanced/ capstone level courses with 12 credits from their DSC/ DSE/ Minor courses depending on their pathway choice. The Minor courses can be of level 300 or above.

** The students pursuing the 4-year honours with research have to complete a project with 12 credits and for the 4-year honours degree students have to complete a project with 8 credits and DSC/ DSE capstone/ advanced level course in the 8th semester.

i. The 20% syllabus of each course will be prepared by the teacher as 'Teacher Specific Content' and will be evaluated under CCA.

ii. In case of MDC, SEC, VAC courses coming under 3rd & 4th semester, college should make necessary arrangements to give adequate preference to courses designed by language departments. MDC in the 3rd semester can be Kerala Specific Content.

Academic Levels of Pathway Courses

Semester	Difficulty level	Nature of Course
1 & 2	100-199	Foundation-level or introductory courses
3 & 4	200-299	Intermediate level courses
5 & 6	300-399	Higher level courses
7 & 8	400-499	Advanced/Capstone level courses

Signature Courses

i. With a prior recommendation of BoS and the approval of academic council, each faculty member can design and offer at least one signature course in every semester, which may be offered as DSE /SEC/ VAC.

ii. The College will publish a list of signature courses in DSE/ SEC/ VAC offered by the faculty members with a prior recommendation of BoS and the approval of the academic council.

iii. The College may empanel distinguished individuals who have excelled in their field of specialization like science and technology, industry, commerce, social research, media, literature, fine arts, civil services etc. as adjunct faculty as per the UGC guidelines with the approval of the College. With a prior recommendation of BoS and the approval of academic council, the adjunct faculty can offer SEC/VAC as a signature course.

iv. Ad hoc/ Guest faculty/ Visiting faculty/ Visiting Scholars can also offer DSE/ SEC/ VAC as signature courses with a prior recommendation of BoS and the approval of academic council.

v. The faculty concerned may design the particular course and it should be forwarded to the concerned BoS after the approval of the Academic Committees formed as part of this regulations.

vi. The examinations and evaluation of the signature courses designed by the faculty shall be conducted by the faculty themselves and an external expert faculty chosen by the college from a panel of experts submitted by the faculty and recommend by the BoS concerned.

Programme Pathways and Curriculum Structure

Students who have joined for any programme under these regulations shall have the option to choose the following pathways for their UG degree and Honours programme.

i. **Degree with single Major**: A student pursuing the FYUG programme in a specific discipline shall be awarded a Major degree if he secures at least 50% of the total credits in the specific discipline required for the award of the Degree in that Discipline. Example: Physics Major/ Economics Major/ Commerce Major
ii. **Degree Major with Minor**: If a student pursuing the FYUG Programme is awarded a Major Degree in a particular discipline, he/she/they are eligible to be awarded a Minor in another discipline of his choice, if he earns a minimum of 32 credits (approximately 25% of credit required for the three-year programme) from 8 pathway courses in that discipline. Example: Physics Major with Chemistry Minor/ Chemistry Major with English Minor/ Commerce Major with Economics Minor/ English Major with Functional English Minor/ Hindi Major with Malayalam Minor etc.
iii. **Major with Multiple Disciplines** of Study: This pathway is recommended for students who wish to develop core competencies in multiple disciplines of study. In this case, the credits for the minor pathway shall be distributed among the constituent disciplines/ subjects. If a student pursuing FYUG Degree Programme is awarded a major Degree in a particular discipline, he/she/they are eligible to get mentioned his core competencies in other disciplines of his choice if he has earned 12 credits from the pathway courses of that discipline. Example: Physics Major with Minors in Chemistry and Mathematics, Economics Major with Minors in History and English, Commerce Major with Minors in Economics and Statistics.
iv. **Interdisciplinary Major**: For these programme pathways, the credits for the major and minor pathways shall be distributed among the constituent disciplines/subjects to attain core competence in the interdisciplinary programme. Example: Econometrics Major, Global Studies Major, Biostatistics Major.
v. **Multi-Disciplinary Major**: For multidisciplinary major pathways, the credits for the major and minor pathways will be distributed among the broad disciplines such as Life Sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc. Example: Life Science, Data Science, Nano Science.
vi. **Degree with Double Major**: A student who secures a minimum of 50% credits from the first major will be awarded a second major in another discipline if he could secure 40% of credit from that discipline for the 3-year/ 4-year UG degree to be awarded a double major degree. Example: Physics and Chemistry Major, Economics and History Major, Economics and History Major, Commerce and Management Major.

Pathway Option 1 - Degree Major or Major with Multiple Disciplines of Study

Course Components	No. of Courses											
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Remarks**	**Semester 7**	**Semester 8**	**Total**
DSC A (4 Credit /Course)	1(P)	1(P)	3 (2 P)	3 (2 P)		5	4	17	7 Out of 17 can be opted as DSE	3	2	22
DSC B & C (4 Credit /Course)	2(P)	2(P)	1(P) (B or C)	1(P) (C or B)				6		3		9
Multidisciplinary Courses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1 * *	1**	3	*Recommended that the course may be offered by the English Department ** From DSC A only			3
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1**	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department ** From DSC A only			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC / DSE for Honours**	

Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2 + 1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**Total Credits 177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Pathway Option 2 - Major with Minor

Course Components	**No. of Courses**											
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Remarks**	**Semester 7**	**Semester 8**	**Total**
DSC A (4 Credit /Course)	1(P)	1(P)	3 (2P)	3 (2P)		4	3	15	7 Out of 15 can be opted as DSE	3	2	20
DSC B (4 Credit /Course)	2(P)	2(P)	1(P)	1(P)		1	1	8	1 Out of 8 can be opted as DSE	3		11
Multidisciplinary Courses (MDC)/ (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1**	1**	3	*Recommended that the course may be offered by the English Department ** From DSC A only			3

Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1**	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department ** From DSC A only			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC/ DSE for Honours**	
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2+1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**Total Credits 177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Pathway Option 3 - Double Major

Course Components	**No. of Courses**											**Total**
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Remarks**	**Semester 7**	**Semester 8**	
DSC A (4 Credit /Course)	1(P)	1 (P)	2(2P)	2(1P)		4	3	13	7 Out of 13 can be opted as DSE	3	2	18
DSC B (4 Credit /Course)	2(P)	2(P)	2(1P)	2(2P)		1	1	10	2 Out of 10 can be opted as DSE	3		13

Multidisciplinary Courses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1	1	3	*Recommended that the course may be offered by the English Department			3
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC/ DSE for Honours**	
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2+1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**Total Credits 177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Note: In all the above 3 tables "(P)" means courses with practical

Course Structure of Various Pathways based on Credit Requirements

The FYUG Programmes consist of the following categories of courses and the minimum credit requirements for each of them shall be as follows:

Table 1: FYUGP Course Structure – Major with Minors

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	Major	68	88
2	Minor/ Minors	24	24+12*
3	Multi-disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Course (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Project / Dissertation		12**
	Total Credits	133	177

* Students can acquire 12 credits from their DSC/ DSE- Minor courses (300-399 level) depending upon their pathway choice.

** Students pursuing a four-year Honours degree are required to complete an 8-credit project as well as one capstone course from their chosen pathway, either DSC or DSE (400-499 level).

Table 2: FYUGP Course Structure – Double Major

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	First Major	52	72
2	Second Major	40	52
3	Multi-disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Course (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Project/(8 Credit project + 1 capstone course)		12
	Total Credits	133	177

Table 3: FYUGP Course Structure – Multidisciplinary

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	Multidisciplinary Major	52	72
2	Multidisciplinary Minors	40	52
3	Multi-disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Course (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Project / (8 Credit project + 1 capstone course)		12
	Total Credits	**133**	**177**

Guidelines for Acquiring Credit from Other Institutions/Online/Distance Mode

i. A student shall register to a minimum of 16 credit per semester from the college/ department where he/she/they officially admitted for a particular programme. However, students enrolled for a particular programme in one institution can simultaneously enrol for additional credits from other HEIs within the University or outside University subject to a maximum of 30 credits per semester including the 16 institutional credits.
ii. The College shall publish a list of courses that are open for admission for students from other institutions well in advance before the commencement of each semester.
iii. Each BoS shall prepare and publish a list of online courses at different levels before the commencement of each semester offered in various online educational platforms recognized by the Academic Council of the college, which can be opted by the students for acquiring additional credits.
iv. BoS shall prepare and publish a list of allied/ relevant pathway courses before the commencement of each semester offered by other Board of Studies that can be considered as pathway course for major/ minor for their disciplines at different levels.
v. At the end of each semester the college will include the credit acquired by the student through online courses in their semester grade card subject to a maximum of 30 credits.

Attendance

i. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if he has completed 75% of the prescribed classroom activities in physical, online, or blended modes, including any makeup activities as specified by the course faculty of that particular course.
ii. A student is eligible for attendance as per the existing university and government orders which includes participation in a meeting, or events organized by the college or the university, a regularly scheduled curricular or extracurricular activity prescribed by the college or the university. Due to unavoidable or other legitimate circumstances such as illness, injury, family emergency, care-related responsibilities, bad or severe weather conditions, academic or career-related interviews students are eligible for authorized absence. Apart from this, all other eligible leaves such as maternity leave, and menstrual leave shall also be treated as authorized absences.
iii. The condonation facility can be availed as per the university norms.

Workload

i. The workload of a faculty who offers only lecture courses during an academic year shall be 32 credits.
ii. The workload of a faculty offering both practical courses and theory courses may be between 24-32 credits per academic year.
iii. An academic year shall consist of two semesters.
iv. To protect the existing language workload, college should make necessary arrangements to give adequate preference to those courses designed by language departments coming under MDC, SEC and VAC of 3rd & 4th semester. It is recommended that the MDC offered in the third semester shall be based on Indian

Knowledge Systems or Nation-specific topics and may be offered by the Other Languages department or any other department as may be seen fit. Additionally, the SEC in the fourth semester may be offered by the English Department and of the VACs in the third and fourth semesters, one may be offered by the Other Languages Department and the other may be offered by the English Department. These recommendations may be modified as per the recommendations of the SHC-UGP Academic Monitoring Committee.

v. Programme wise workload calculation will be as per the FYUGP workload ordinance 2024.
vi. The teachers given the administrative responsibilities in the department and college level may give a relaxation in their work load as specified in the UGC regulations 2018.

Credit Transfer and Credit Accumulation

i. The college will establish a digital storage (DIGILOCKER) of academic credits for the credit accumulation and transfer in line with ABC.

ii. The validity of credits earned shall be for a maximum period of seven (7) years or as specified in the university/ UGC regulations. The students shall be required to earn at least 50% of the credits from the College.

iii. Students shall be required to earn the required number of credits as per any of the pathway structure specified in this regulation for the award of the degree.

Outcome Based Approach

The curriculum will be designed based on Outcome Based Education (OBE) practices. The Graduate Attributes (GA) and Programme Outcomes (PO) will be defined and specified in the syllabus of each programme.

Assessment and Evaluation

i. The assessment shall be a combination of Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).

ii. 30% weightage shall be given for CCA. The remaining 70% weight shall be for the ESE.

iii. Teacher Specific Content will be evaluated under CCA.

iv. CCA will have two subcomponents Formative Assessment (FA) and Summative Assessment (SA). Each of these components will have equal weightage and to be conducted by the course faculty/ course coordinator offering the course.

v. FA refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, module or course. FA is to encourage students to build on their strengths rather than fixate or dwell on their deficits. FA can help to clarify and calibrate learning expectations for both students. FA will help students become more aware of their learning needs, strengths, and interests so they can take greater responsibility over

their own educational growth. FA will be prerogative of the course faculty/ course coordinator based on specific requirement of the student.

vi. Suggestive methods of FA are as follows: (anyone or in combinations as decided by the course faculty/ course coordinator)

a. Practical assignment
b. Observation of practical skills
c. Viva voce
d. Quiz
e. Interview
f. Oral presentations
g. Computerized adaptive testing
h. In-class discussions
i. Group tutorial work
j. Reflection writing assignments
k. Home assignments
l. Self and peer Assessments
m. Any other method as may be required for specific course/ student by the course faculty/ course coordinator.

vii. Summative Assessments (SA) are used to evaluate student learning, skill acquisition, and academic achievement at the conclusion of a defined instructional period- typically at the end of a project, unit, module, course or semester. SA may be a class tests, assignments, or project, used to determine whether students have learned what they were expected to learn. It will be based on evidence, collected using single or multiple ways of assessment. The systematically collected evidences should be kept in record by course faculty/ course coordinator and the marks should be displayed on the college notice board/ other official digital platforms of the college before the end semester examinations.

viii. The method of SA will be as follows: (any one as decided by the course faculty/ course coordinator)

a. Written test
b. Open book test
c. Laboratory report
d. Problem based assignments
e. Individual project report
f. Case study report
g. Team project report
h. Literature survey
i. Standardized test
j. Any other pedagogic approach specifically designed for a particular course by the course faculty/ course coordinator.

viii. A student may repeat SA only if for any compulsive reason due to which the student could not attend the assessment.

ix. The prerogative of arranging a CCA lies with the course faculty/ course coordinator with the approval of SHC-UGP Academic Committee based on justified reasons.

x. The course faculty/ course coordinator shall be responsible for evaluating all the components of CCA. However, the college may involve any other person (External or Internal) for evaluation of any or all the components as decided by the Principal/Controller of Examinations from time to time in case any grievances are raised.

xi. Written tests shall be precisely designed using a variety of tools and processes (e.g., constructed responses, open-ended items, multiple-choice), and the students should be informed about the evaluation modalities before the commencement of the course.

xii. The course faculty may provide options for students to improve their performance through continuous assessment mechanism.

xiii. There shall be theory and practical examinations at the end of each semester.

xiv. Regarding evaluation, one credit may be evaluated for 25 marks in a semester; thus, a 4-credit course will be evaluated for 100 marks; 3-credit courses for 75 marks and 2-credit courses for 50 marks.

xv. All examinations will be conducted by the College and will be evaluated at the College itself.

xvi. Individual Learning Plans (ILPs) and/ or specific assessment arrangements may be put in place for differently abled students. Suitable evaluation strategies including technology assisted examinations/ alternate examination strategies will be designed and implemented for differently abled students.

Practical Examination

i. The end semester practical examination will be conducted and evaluated by the institution.

ii. There shall be a CCA for practical courses conducted by the course faculty/ course coordinator.

iii. The scheme of evaluation of practical courses will be as given below:

Components for the Evaluation of Practical Courses	Weightage
CCA of practical/practicum.	30%
ESE of practical/practicum.	70%

iv. Those who have completed the CCA alone will be permitted to appear for the ESE.

v. For grievance redressal purpose, the university shall have the right to call for all the records of CCA.

vi. Duration of Examination: Questions shall be set as per the defined Outcome .The duration of the examinations shall be as follows.

Mode	Time (in Hours)
Written Examination	2
Multiple Choice	1.5
Open Book	2
Any Other Mode	2

Evaluation of Project/Dissertation

The evaluation of project work shall be CCA with 30% and ESE 70%. The scheme of evaluation of the Project is given below:

Project type	Maximum Marks	CCA	ESE
Research Project of Honours with Research (12 credits)	200	60	140
Project of Honours (8 credits)	100	30	70

Evaluation of Internship

The evaluation of internship shall be done by a committee constituted by the Department Council. The scheme of CCA and ESE is given below:

Components of Evaluation of Internship	Weightage	Marks for Internship 2 Credits/ 50 Marks
CCA	30%	15
ESE	70%	35

The department council may decide any mode for the completion of the Internship. If in case evaluation is not specified in any of the selected internship programme, institution can adopt a proper evaluation method as per the weightage specified in the table above.

Letter Grades and Grade Points

Mark system is followed for evaluating each question. For each course in the semester, letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given below,

i. The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.

ii. Based on the marks obtained, the weighted grade point will be mentioned in the student's grade cards.

Letter Grade	Grade Point	Percentage of Marks (Both Internal & External Marks put together)	Class
O (Outstanding)	10	95% and above	First Class with Distinction
A+ (Excellent)	9	85% and above but below 95%	
A (Very good)	8	75% and above but below 85%	
B+ (Good)	7	65% and above but below 75%	First Class
B (Above average)	6	55% and above but below 65%	
C (Average)	5	45% and above but below 55%	Second Class
P (Pass)	4	35% and above below 45% Aggregate (external and internal put together) with a minimum of 30% in external	Third Class
F (Fail)	0	Below an aggregate of 35%or below 30% in external evaluation	Fail
Ab (Absent)	0		Fail

iii. When students take audit courses, they may be given pass (P) or fail (F) grade without any credits.

Computation of SGPA and CGPA

The following method is recommended to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

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

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Si is the SGPA in the i^{th} semester, Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

$$SGPA = \frac{Sum\ of\ the\ credit\ points\ of\ all\ courses\ in\ a\ semester}{Total\ Credits\ in\ that\ Semester}$$

Illustration – Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	DSC A	4	A	8	4 x 8 = 32
I	DSC B	4	B+	7	4 x 7 = 28
I	DSC C	4	B	6	4 x 6 = 24
I	MDC	3	B	6	3 x 6 = 18

I	AEC 1	3	O	10	3 x 10 = 30
I	AEC 2	3	C	5	3 x 5 = 15
	Total	21			147
	SGPA				147/21 = 7

The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \frac{Sum\ of\ the\ credit\ points\ of\ all\ courses\ in\ six\ or\ eight\ semesters}{Total\ Credits\ in\ Six\ (133)\ or\ Eight\ (177)\ semesters}$$

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

Implementation and Monitoring of SHC-UGP

i. The implementation and monitoring of SHC-UGP will be carried out by duly appointed bodies/committees of the college such as the Academic Council, the various Boards of Studies and the Academic Monitoring Committee.

ii. Academic Council

Among its other functions, the Academic Council of the College shall:

i. Scrutinize and approve all the proposals submitted by the Board of Studies of each Department with regard to the SHC-UGP details such as, academic pathways, allowed syllabi enrichment/ updating, details of elective courses, Online courses, blended teaching, courses offering to the students of other HEIs, panel of examiners, summative and formative evaluation tools proposed by the course faculty concerned, new courses and syllabus proposed by the faculty members as signature courses etc.

ii. The Academic Council can differ on any proposal and it shall have the right to return the matter for reconsideration to the Board of Studies concerned or reject it, after giving sufficient reasons to do so.

iii. Undertake the scrutiny of all documents related to Teacher Specific Content.

iv. Recommend to the College Governing Council for starting innovative programmes using the flexibility and holistic nature of the SHC-UGP curriculum framework.

iii. Board of Studies

Among its other functions, the Board of Studies of each Department shall:

i. Prepare teacher specific content of syllabi for various courses keeping in view the objectives of the SHC-UGP and submit the same for the approval of the Academic Council.

ii. Scrutinize the signature course content and its evaluation techniques.

iii. Suggest methodologies for innovative teaching and evaluation techniques.
iv. Suggest panel of examiners to the Office of the Controller of Examinations.
v. Coordinate research, teaching, extension and other academic activities in the department.

iv. SHC-UGP Academic Monitoring Committee

The SHC-UGP Academic Monitoring Committee shall be constituted under the Chairmanship of the Principal, with the Academic Coordinator as the Convenor, shall be entrusted to oversee the implementation and monitoring of the SHC-UG programme.

i. The Academic Monitoring Committee will collect and whet the proposals submitted by the Board of Studies of each Department with regard to the SHC-UGP and duly forward them to the Academic Council.
ii. It will oversee and coordinate the activities undertaken for the successful implementation of SHC-UGP in the College and will function as an advisory body in such matters.

Power to Remove Difficulties

If any difficulty arises in giving effect to the provisions of these Regulations, the Principal may by order make such provisions which appears to him/her to be necessary or expedient for removing the difficulty. Every order made under this rule shall be subject to ratification by the appropriate authorities.

Modifications to the Regulations

Notwithstanding anything contained in these Regulations, any amendments or modifications issued or notified by the University Grants Commission or the State Government or the Mahatma Gandhi University from time to time, shall be incorporated into these Regulations by the appropriate regulatory bodies of the College and shall constitute an integral part thereof.

SYLLABUS INDEX

SEM	COURSE CODE	COURSE TITLE	COURSE LEVEL	Credits	Hours per Week	
					Theory	*Practical*
DISCIPLINE SPECIFIC COURSES (DSC)						
I	24UCAPDSC101	Programming in C	100-199	4	3	2
II	24UCAPDSC102	OOPS with C++	100-199	4	3	2
III	24UCAPDSC201	Data Structures using C++	200-299	4	3	2
	24UCAPDSC202	DBMS	200-299	4	3	2
	24UCAPDSC203	Digital Electronics	200-299	4	4	0
IV	24UCAPDSC204	Programming in Java	200-299	4	3	2
	24UCAPDSC205	Advanced Web Technologies	200-299	4	3	2
	24UCAPDSC206	Operating System	200-299	4	4	0
V	24UCAPDSC301	Python for Data Science	300-399	4	3	2
	24UCAPDSC302	Computer Networks	300-399	4	4	0
	24UCAPDSC303	Software Engineering	300-399	4	4	0
VI	24UCAPDSC304	Machine Learning	300-399	4	3	2
	24UCAPDSC305	Software Development	300-399	4	3	2
	24UCAPDSC306	Data Mining	300-399	4	3	2
VII	24UCAPDSC401	Research Methodology	400-499	4	4	0
	24UCAPDSC402	Software Testing Methodologies	400-499	4	4	0
	24UCAPDSC403	Design and Analysis of Algorithms	400-499	4	4	0
	24UCAPDSC404	Artificial Intelligence	400-499	4	3	2
	24UCAPDSC405	Internet of Things	400-499	4	4	0
	24UCAPDSC406	Big Data Analytics	400-499	4	4	0
VIII	24UCAPDSC407	Research and Publication Ethics	400-499	4	4	0

	24UCAPDSC408	Deep Learning	400-499	4	3	2
DISCIPLINE SPECIFIC ELECTIVE COURSES(DSE)						
V/VI	24UCAPDSE301	Microprocessors and Assembly Language Programming using 8086	300-399	4	3	2
	24UCAPDSE302	System Software	300-399	4	4	0
	24UCAPDSE303	Introduction to Cloud Technology	300-399	4	4	0
	24UCAPDSE304	R Programming	300-399	4	3	2
	24UCAPDSE305	Basic Android	300-399	4	3	2
	24UCAPDSE306	Network Security	300-399	4	4	0
	24UCAPDSE307	Theory of Automata	300-399	4	4	0
	24UCAPDSE308	Computer Graphics	300-399	4	4	0
	24UCAPDSE309	Image Processing	300-399	4	4	0
VIII	24UCAPDSE401	Natural Language Processing	400-499	4	3	2
	24UCAPDSE402	Blockchain Technologies	400-499	4	3	2
	24UCAPDSE403	Generative AI	400-499	4	3	2
DISCIPLINE SPECIFIC COURSES (DSC) - Minor Pathway						
I/ II	24UCAPDSC103	Desktop Engineering	100-199	4	3	2
	24UCAPDSC104	Introduction to Analytics with Excel	100-199	4	3	2
	24UCAPDSC105	Information Technologies	100-199	4	3	2
	24UCAPDSC106	Fundamentals of Business Analytics with Python	100-199	4	3	2
	24UCAPDSC107	Foundations of Digital Literacy	100-199	4	3	2
III/ IV	24UCAPDSC207	Problem Solving Techniques	200-299	4	3	2
	24UCAPDSC208	Business Intelligence and Data Visualization using Power BI	200-299	4	3	2
	24UCAPDSC209	Internet and Web Technologies	200-299	4	3	2
MULTIDISCIPLINARY COURSES (MDC)						
I	24UCAPMDC101	Computer Hardware and Assembling	100-199	3	2	2
	24UCAPMDC102	Cyber Laws and Online Safety	100-199	3	2	2

II	24UCAPMDC103	Basic IT Tools	100-199	3	2	2
III	24UCAPMDC201	Web Designing	200-299	3	3	0
SKILL ENHANCEMENT COURSES (SEC)						
IV	24UCAPSEC201	Advanced Excel	200-299	3	3	0
V	24UCAPSEC301	AI Tools	300-399	3	3	0
VI	24UCAPSEC302	Technical Writing using LATEX	300-399	3	3	0
VALUE ADDITION COURSES (VAC)						
III	24UCAPVAC201	IT, Environment and Holistic Living	200-299	3	3	0
	24UCAPVAC202	White Hat Hacking	200-299	3	3	0
IV	24UCAPVAC203	Green Computing	200-299	3	3	0
	24UCAPVAC204	Information and Cyber Ethics	200-299	3	3	0
VI	24UCAPVAC301	Cyber Forensics and Data Security	300-399	3	3	0
	24UCAPVAC302	Cyber Security and Ethical Hacking	300-399	3	3	0
	24UCAPVAC303	Health and Wellness	300-399	3	3	0

PROPOSED PROGRAMME PATHWAY FOR BSc(Hons) COMPUTER APPLICATIONS

SEM	Course Code	Course Title	Course Level	Credits	Hours per Week	
					Theory	*Practical*
I	24UCAPDSC101	Programming in C	100-199	4	3	2
	-	Mathematics– Minor (B)	100-199	4	3	2
	-	Statistics – Minor (C)	100-199	4	3	2
	-	AEC – English	100-199	3	3	0
	-	AEC – Other Languages	100-199	3	3	0
	-	MDC	100-199	3	2	2
				21	**17**	**8**
II	24UCAPDSC102	OOPS with C++	100-199	4	3	2
	-	Mathematics – Minor (B)	100-199	4	3	2
	-	Statistics – Minor (C)	100-199	4	3	2
	-	AEC – English	100-199	3	3	0
	-	AEC – Other Languages	100-199	3	3	0
	-	MDC	100-199	3	2	2
				21	**17**	**8**
III	24UCAPDSC201	Data Structures using C++	200-299	4	3	2
	24UCAPDSC202	DBMS	200-299	4	3	2
	24UCAPDSC203	Digital Electronics	200-299	4	4	0
	-	Mathematics - Minor (B)	200-299	4	3	2
	-	MDC	200-299	3	3	0
	-	VAC	200-299	3	3	0
				22	**19**	**6**
IV	24UCAPDSC204	Programming in Java	200-299	4	3	2
	24UCAPDSC205	Advanced Web Technologies	200-299	4	3	2
	24UCAPDSC206	Operating System	200-299	4	4	0
	-	Statistics – Minor (C)	200-299	4	3	2
	-	SEC	200-299	3	3	0
	-	VAC	200-299	3	3	0
				22	**19**	**6**
Summer Internship				**2**	**-**	**60**
V	24UCAPDSC301	Python for Data Science	300-399	4	3	2

SEM	Course Code	Course Title	Course Level	Credits	Hours per Week	
					Theory	*Practical*
	24UCAPDSC302	Computer Networks	300-399	4	4	0
	24UCAPDSC303	Software Engineering	300-399	4	4	0
	-	DSE I	300-399	4	3	2
	-	DSE II	300-399	4	4	0
	-	SEC	300-399	3	2	1
				23	**21**	**4**
VI	24UCAPDSC304	Machine Learning	300-399	4	3	2
	24UCAPDSC305	Software Development	300-399	4	3	2
	24UCAPDSC306	Data Mining	300-399	4	3	2
	-	DSE III	300-399	4	4	0
	-	SEC	300-399	3	2	1
	-	VAC	300-399	3	3	0
				22	**19**	**6**
Exit at 3rd Year with 133 Credits – BSc Degree						
VII*	24UCAPDSC401	Research Methodology	400-499	4	4	0
	24UCAPDSC402	Software Testing Methodologies	400-499	4	4	0
	24UCAPDSC403	Design and Analysis of Algorithms	400-499	4	4	0
	24UCAPDSC404	Artificial Intelligence	400-499	4	3	2
	24UCAPDSC405	Internet of Things	400-499	4	4	0
	24UCAPDSC406	Big Data Analytics	400-499	4	4	0
** 3 Courses in Sem 7 can be taken from minor pathway at 300-399 level (for single minor pathway)*				**24**	**23**	**2**
VIII	24UCAPDSC407	Research and publication Ethics	400-499	4	4	0
	24UCAPDSC408	Deep Learning	400-499	4	3	2
	-	12 Credit Project / 8 credit project + 1DSE	-	12	-	-
				20	-	-
Completion of the Programme at 4th Year with 177 Credits – BSc Honours Degree						

2. SYLLABUS FOR DISCIPLINE SPECIFIC COURSES

COURSE 01

Discipline/Programme	Computer Science
Semester	I
Type of Course	DSC
Course Code	24UCAPDSC101
Course Title	**Programming in C**
Course Level	100-199
Course Summary	Programming in C course equips you with the fundamentals of programming, often being a stepping stone to other languages. By the end of the course , students are able to write basic C programs to solve various problems with a foundation to delve deeper into the programming concepts .
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Interpret the fundamental concepts like datatype, tokens, operators, expression and evaluate an expression	Understand	PO1,PO2
2	Develop C programs that interact with users, make decisions, repeat tasks, manage data in arrays.	Apply	PO1,PO2
3	Develop C programs using functions, strings, pointers.	Apply	PO2,PO1
4	Create a C program using the user defined data structure, file handling.	Apply	PO8, PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to C Programming (8 hours)			
	1.1	Basics of C Programming Language, Structure of C Program.	2	CO1
	1.2	Tokens, Keywords, Identifiers, Data types, Variables and Constants.	2	CO1
	1.3	Operators and Expressions.	2	CO1
	1.4	Expression, Evaluation–precedence and associativity, Type Conversions.	2	CO1
2	Input/Output, Control Flow & Arrays (14 hours)			
	2.1	Input-Output- Unformatted and Formatted Input and Output Functions, Escape Sequences.	2	CO2
	2.2	Control Statements- Selection Statements – if, if-else, nested if, if else if ,switch statement	3	CO2
	2.3	Iterative Statements–while, for, do-while, nested for loop, Special Control Statement–goto, break, continue, return, exit.	6	CO2
	2.4	Arrays-definition, Accessing array, Type of array, single dimensional array, two dimensional array, example programs using arrays (including linear search, bubble sort and matrix operations)	3	CO2
3	Strings, Functions, Storage Classes and Pointers (11 hours)			
	3.1	string, string operations, string functions in c, example programs using strings (including linear search, sort)	3	CO3
	3.2	Concept of Function, user defined Functions, Call-by-Value Vs Call-by-reference, Passing Arrays to Functions, Recursion	3	CO3
	3.3	Storage Classes, Scope and lifetime of variables	2	CO3
	3.4	Pointers: Introduction, Address of Operator (&), Pointer Arithmetic, Arrays and Pointers, Pointers and Strings, Pointers and functions, Array of Pointers	3	CO3
4	User Defined Data types and File Management (12 hours)			
	4.1	Structure: Declaring a Structure and its members, Accessing members of a Structure, Array of Structures, Pointers to structures, Structures and functions	3	CO4
	4.2	Union: Declaring a Union and its members, Structures vs Unions, Initialization Union, Accessing members of a Union, Enumeration Types.	3	CO4

	4.3	Files Management: Defining and opening a file, closing file, Input/output operations on files, predefined streams, Error handling I/O Operations, Random access to files	4	CO4
	4.4	Role of C Preprocessor - macro substitution, file inclusion, Dynamic memory allocation in C	2	CO4

Practicals (30 Hrs)

- Simple programs to familiarize printf() and scanf() functions
- Programs based on decision making statements, break, goto, continue, switch
- Programs using Loop controls statements
- Programs Based on One dimensional and two-dimensional arrays (linear search, bubble sort, matrix addition, multiplication, transpose etc.)
- Programs on Strings and string handling functions
- Programs using the concept of Pointers, operations on pointers, Pointers to one dimensional array
- Programs using the concept of functions, call by value, call by reference, Recursion
- Programs based on structure and union, array of structures, Pointer to structure, structure as argument to functions
- Simple programs using pointers and malloc ()
- Programs using concept of files

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.*

	Practical: *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. C Programming Absolute Beginner's Guide by Greg Perry and Dean Miller.
2. The C Programming Language by Brian W. Kernighan
3. Programming in ANSI C by E Balagurusamy

COURSE 02

Discipline/Programme	Computer Science
Semester	II
Type of Course	DSC
Course Code	24UCAPDSC102
Course Title	**OOPS with C++**
Course Level	100-199
Course Summary	OOPS with C++ syllabus is designed to teach students the fundamentals of OOP and to understand object-oriented programming.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Implement the programmes with the concepts of object-oriented programming language and statements.	Apply	PO1
2	Modify the C++ programmes by reuse the codes having C++ class concepts.	Apply	PO1, PO8
3	Apply the concept of polymorphism.	Apply	PO1, PO2
4	Implement the concept of constructors, inheritance and files.	Apply	PO1, PO2, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Programming(10 hrs)			
	1.1	Evolution of Programming methodologies, Procedure oriented Vs Object oriented programming	2	CO1
	1.2	Characteristics of OOPs	2	CO1
	1.3	Input and output statements	2	CO1
	1.4	Decision and loop statements, Arrays, string and structures	1	CO1
	1.5	Defining class, data members and member functions.	1	CO1
	1.6	Access Specifiers: private, protected and public	1	CO1
	1.7	Significance of scope resolution operator, defining member function inside and outside the class	1	CO1
	Constructors and Destructors (10 Hours)			
2	2.1	Introduction to constructor and destructor	2	CO4
	2.2	Types of constructors	2	CO4
	2.3	Characteristics of constructor	2	CO4
	2.4	Constructor overloading	2	CO4
	2.5	Destructor and its characteristics	2	CO4
	Polymorphism, Inheritance and Pointers (12 Hours)			
3	3.1	Polymorphism: runtime and compile time polymorphism	2	CO3
	3.2	Function overloading	2	CO3
	3.3	Operator overloading and rules for operator overloading	2	CO3
	3.4	Inheritance and need for inheritance	2	CO4
	3.5	Different forms of inheritance and Significance of ‘virtual’ keyword	2	CO4

	3.5	Pointers in C++	2	CO3
	File Handling and Error Handling (13 Hours)			
4	4.1	Virtual function, Friend function and static function	3	CO3
	4.2	File Handling	2	CO4
	4.3	Different operations in file; opening and closing a file,	2	CO4
	4.4	Reading and writing operations in file	3	CO4
	4.5	Error handling in C++	3	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method may be required for a specific course by the course faculty*. **Practical:** *Observation of practical skills , Laboratory record, Any other method as may be required for specific courses by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. “Object Oriented Programming with C++” by E. Balaguruswamy:
2. “Mastering C++”, by K. R Venugopal
3. “The C++ Programming Language”, by Bjarne Stroustrup

COURSE 03

Discipline/Programme	Computer Science
Semester	III
Type of Course	DSC
Course Code	24UCAPDSC201
Course Title	**Data Structures using C++**
Course Level	200-299
Course Summary	This course covers the fundamental concepts of data structures and algorithms, providing a strong foundation for efficient program design and problem solving.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4
Pre-requisite, if any	Programming in C++

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Demonstrate a strong understanding of fundamental data structures.	Understand	PO1
2	Interpret the strengths and weaknesses of each algorithm in terms of efficiency and suitability for different data sizes and types.	Understand	PO2
3	Build stacks and queues using arrays and perform different operations.	Apply	PO1, PO2, PO8
4	Build a linked list ,tree and graph and perform various operations .	Apply	PO8, PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Data Structures(8 hours)			
	1.1	Definition, Classification of Data structure and operations	1	CO1
	1.2	Time and space complexity of algorithms	2	CO1
	1.3	Arrays: - Definition, Types, memory representation, operations	5	CO1
2	Searching and Sorting Techniques(7 hours)			
	2.1	Searching Techniques -Linear search, Binary search, Iterative and Recursive method, Divide and Conquer method	2	CO2
	2.2	Sorting Techniques- Selection sort, Bubble sort, insertion sort, Quick sort and Merge sort	5	CO2
3	Overview of Stack and Queue (16 hours)			
	3.1	Stack overview- Definition, Array representation of stack, Operations on stack.	2	CO3
	3.2	Applications of stack -reversing a string , Infix, prefix and postfix notations, Conversion of an arithmetic expression from Infix to postfix, postfix evaluation.	6	CO3
	3.3	Queue- Definition, Array representation of queue, Types of Queue: Simple queue, Circular queue, Double ended queue (de-queue), Priority queue, Operations on all types of Queues, Applications of queues	8	CO3
	Linked List, Tree and Graph(14 hours)			

4	4.1	Linked list - Definition, Types-singly linked list, doubly linked list, circular linked list, doubly circular linked list and its operations.	6	CO4
	4.2	Tree-Definition, types of trees- Binary Tree, Binary Search Tree and its operations.	4	CO4
	4.3	Graph as Data structure- Definition, Types and its operations-BFS, DFS.	4	CO4

Practicals (30 Hrs)

- Array operations-insertion, deletion, merging two arrays
- Implement linear search, binary search
- Implement selection sort, bubble sort, insertion sort, quick sort, merge sort
- Implement Stack using array, linked list
- Infix expression into its postfix expression, Evaluation of a postfix expression
- Implement Queue using array, linked list
- Implement circular queue- insertion, deletion, Traversal
- Implement priority queue- insertion, deletion, Traversal
- Implement a singly linked list-creation, insertion, deletion, search, concatenate two linked lists, interchange any two nodes in a list, sort based on information field
- Implement a doubly linked list of integers-create, insertion, deletion, traversal
- Implement a circular linked list, doubly circular linked list
- Implement a binary search tree – creation, traversal
- Implement graph-creation, BFS, DFS

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*.

	Practical: *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Data Structures Through C++ Paperback – 28 February 2003 by Yashavant Kanetkar , BPB publications
2. Data Structures and Algorithms in Java by Robert Lafore
3. Introduction to Algorithms by Thomas H. Cormen, Chales E. Leiserson, Ronald L.Rivest and Clifford Stein.

COURSE 04

Discipline/Programme	Computer Science
Semester	III
Type of Course	DSC
Course Code	24UCAPDSC202
Course Title	**DBMS**
Course Level	200-299
Course Summary	DBMS is fundamental for all application development. This course examines principles of DBMS, data analysis, database design, data modelling and database management.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Illustrate the database characteristics, environment, entity-relationship model to develop database designs.	Understand	PO1, PO2
2	Design a database application from a real world scenario using ER model and relational model.	Evaluate	PO1, PO2, PO4, PO6, PO8
3	Develop a relational database by using the Structured Query Language (SQL) syntax for a given application.	Apply	PO1, PO2
4	Apply normalization techniques to remove anomalies in a database.	Analyse	PO1, PO2
5	Infer knowledge about other databases and NoSql	Understand	PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO

	Introduction to Database(10 Hours)			
1	1.1	Introduction: Characteristics of database approach, Database users-DBA, Database designers and end users, Advantages of using DBMS	3	CO1
	1.2	Data Models: Schemas and instances, DBMS architecture and data independence. DBMS language, Database system environment, DBMS Component and modules	3	CO1
	1.3	ER Modeling: Introduction- Entity types, Entity sets, Attributes and Keys, Relationship Types, Relationship Sets relationship instances, Constraints on relationship types, Weak entity types, and sample ER diagrams.	4	CO1
	Concepts of Relational Data Model(10 hours)			
2	2.1	Relational model concepts domains, attributes, tuples and relations, characteristics of relations. Relational Model constraints Relational Databases and relational database schemas, entity integrity, referential integrity and foreign keys with examples, Relational Database design using ER-to-Relational mapping	5	CO2
	2.2	Relational algebra and Relational calculus: SELECT, PROJECT, UNION, INTERSECTION, The CARTESIAN PRODUCT, JOIN, EQUIJOIN, Aggregate functions. Tuple relational calculus, Domain relational calculus.	5	CO2
	DML and DDL commands (8 hours)			
3	3.1	DDL and DML COMMANDS, adding constraints, Substring comparisons using LIKE operator, BETWEEN operator, Complex Queries-Nested queries, EXISTS and UNIQUE functions, NULL values, Renaming of attributes and joining of tables, Aggregate functions and grouping, Managing views.	8	CO3
	Data Normalization and Indexing(17 hours)			
4	4.1	Data Normalization: Informal Design Guidelines for relation schemas, functional dependencies. Normal forms: first, second and third normal form, Boyce- Codd normal form, fourth and fifth Normalisation.	4	CO4

	4.2	Indexing structures for files: types of single level ordered indexes	3	CO4
	4.3	Transaction processing: Introduction to transaction processing Transaction and system concepts, Desirable properties of transactions. Database Security and Authorization: Types of security, control measures, database security and the DBA	3	CO4
	4.4	Introduction about Advanced Topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.	3	CO5
	4.5	NoSQL -Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, Column-oriented NoSQL databases, NoSQL Key/Value databases	4	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:**

	Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.

References:

1. Ramez Elmasri, Shamkant B. Navathe, Database Systems Models, Languages, Design and Application Programming, 6th Ed., Pearson
2. Abraham Silberschatz, Henry F Korth, S. Sudarshan, Data base System Concepts, 5 th Ed.,
3. McGraw Hill. Raghurama Krishnan, Johannes Gehrke, Data base Management Systems, 3 rd Ed., TMH.
4. C. J.Date, Introduction to Database Systems,8th Ed., Pearson

COURSE 05

Discipline/Programme	Computer Science
Semester	III
Type of Course	DSC
Course Code	24UCAPDSC203
Course Title	**Digital Electronics**
Course Level	200-299
Course Summary	This course covers the operation, application, their use in combinatorial and sequential logic circuits. The course also provides a study of Boolean algebra, binary and hexadecimal number systems, binary codes.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Interpret the decimal, binary, octal, hexadecimal number systems, its conversion between the number systems.	Understand	PO1, PO2, PO8
2	Evaluate the Boolean functions and its simplification using K-MAP.	Apply	PO2
3	Design simple combinational and sequential circuit	Apply	PO2
4	Explain the concept of addressing modes	Apply	PO1, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Number System(15 hrs)			
	1.1	Popular number systems(Decimal, Binary, Octal and Hexadecimal)	3	CO1
	1.2	Conversion of all number systems	3	CO1
	1.3	Concept of binary addition and subtraction	3	CO1
	1.4	Complements in binary number systems, 1^s Complement, 2^s Complement and their applications	2	CO1
	1.5	BCD numbers- concept and addition	2	CO1
	1.6	Excess 3 code	2	CO1
2	Boolean Algebra and Gate Networks(17 hrs)			
	2.1	Logic gates– Truth tables and graphical representation,	3	CO2
	2.2	Basic laws of Boolean Algebra, Simplification of Expressions, De Morgan's theorems	3	CO2
	2.3	Canonical expressions, Min terms and Max terms, SOP and POS expressions	3	CO2
	2.4	Simplification of expression using K-MAP (up to 4 variables)	3	CO2
	2.5	Don't care conditions	3	CO2
	2.6	Representation of simplified expressions using NAND/NOR Gates,	2	CO2
3	Sequential and Combinational (15 hrs)			
	3.1	Half adder, Full adder	3	CO3

	3.2	Encoders, Decoder	3	CO3
	3.3	Multiplexers and De-multiplexers	3	CO3
	3.4	parity generator and checker	3	CO3
	3.5	XOR and its applications	3	CO3
4	Registers and Counters (13 hrs)			
	4.1	Flip Flops (Latch, Clocked, RS, JK, T, D and Master slave)	3	CO4
	4.2	Triggering of Flip flops	3	CO4
	4.3	Introduction to Registers-Shift Registers	3	CO4
	4.4	Counters- Synchronous and asynchronous Counter	4	CO4

References:

1. Digital logic and computer design by Morris Mano, 4th Edition, Pearson Publication, Upper Saddle River, Nl07458
2. WAKERLY, 1, f. 2006. Digiml Design: Principles and Pmctices, 4th ed. Uppa Saddle River, NJ: Prentice Hall.
3. WEST& N. E., and K. ESHRAC~HIAN. 2005. Principles of CMOS VLSI Design: A System Peqoective, 2d ed. Reading, MA: Addison-Wesley.
4. Digital Fundamentals by Floyd
5. Digital Electronics by R.P Jain

COURSE 06

Discipline/Programme	Computer Science
Semester	IV
Type of Course	DSC
Course Code	24UCAPDSC204
Course Title	**Programming in Java**
Course Level	200-299
Course Summary	This Course involves a structured syllabus covering fundamental concepts, syntax, object-oriented programming principles, and practical skills necessary to build a strong foundation in core Java.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Illustrate object oriented programming using Java, its data types, type conversion, operators	Understand	PO1
2	Develop the Java programmes using defining classes, invoking methods using libraries.	Understand, Apply	PO2
3	Demonstrate the designing, implementing and testing GUI in Java	Analyse	PO3
4	Design GUI applications in Java	Apply	PO2, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Overview of Java Programming(14 hours)			

	1.1	Overview of Java Object Oriented Programming, Writing a simple Java program, control statements and Selection statements in Java	5	CO1
	1.2	Data types: Integers, Floating point, characters, Boolean, A closer look at Literals, Variables, Conditional statements (if/else, switch), Looping statements (for, while, do-while), Understanding the concept of code blocks and indentation	5	CO1
	1.3	Type conversion and casting, Automatic type promotion in Expressions Arrays, Operators and its precedence, Functions Taking input from the user (using Scanner class), Printing output to the console (using System.out.println)	4	CO1
2	Working with class concepts(13 hours)			
	2.1	Class Fundamentals, Dealing with objects, 'this' keyword and finalise() method, Defining and calling methods, Parameters and arguments, Returning values from methods	5	CO2
	2.2	Method overloading (having multiple methods with the same name but different parameters), using objects as parameters, argument passing	4	CO2
	2.3	Returning objects, access control, final keyword Declaring and initializing arrays, Accessing elements in an array, Looping through arrays, Multidimensional arrays	4	CO2
	Inheritance and Exception Handling in Java(14 hours)			
3	3.1	Inheritance: using super, method overriding, Abstract class, Interfaces and packages, static, abstract keywords	5	CO3
	3.2	Exception Handling in Java, File handling basics (reading from and writing to files), Thread class	4	CO3
4	GUI in Java(9 hours)			
	4.1	GUI in Java: Understand the purpose and differences between AWT and Swing. Explore the basic components offered by AWT (buttons, labels, text fields, windows). Advantages of Swing over AWT (lightweight components, platform independence, richer set of components).	5	CO4
	4.2	Handle user interactions with components using event listeners (e.g., button clicks), Explore different range of components offered by Swing (JButtons,	4	CO4

		JTextFields, JPanels, JTables, JMenus, etc.), Event handling in Swing using action listeners and other event types.		

Practicals (30 hrs)

- Setting Up Your Development Environment - Install JDK and explore a text editor (e.g., Visual Studio Code) or IDE (e.g., Eclipse, IntelliJ IDEA). Write and run a simple Java program to print a message.
- Conditional Statements and Loops - Create a program that utilizes if-else statements for decision-making and for or while loops for repetition. (e.g., Guessing game, calculating factorial)
- Building Methods and Functions - Design methods with parameters and return values. Implement logic for calculations or data manipulation within methods. Call these methods from your main program. (e.g., Area and perimeter calculator, temperature converter)
- Array Operations - programs demonstrating array declaration, initialization, accessing elements, looping through arrays, and searching elements within the array. (e.g., Finding the maximum element, sorting an array)
- Building Classes and Objects - Design a class representing a real-world entity (e.g., Book, Student) with attributes and methods. Create objects of that class and demonstrate accessing object properties and invoking methods.
- Reading and Writing Data - Utilize Scanner class for user input and System.out.println for output. Implement file handling basics
- Handling Exceptions - Write a program that demonstrates handling potential exceptions (e.g., division by zero) using try-catch blocks to prevent program crashes.
- Simple Application - Design a GUI java application with AWT/ Swing components like buttons and a drawing panel. Handle user interactions and perform some actions.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method may be required for specific course by the course faculty*.

	Practical: *Observation of practical skills, Laboratory record, Any other method as may be required for specific course by the course faculty.*
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Java: The Complete Reference by Herbert Schildt
2. Thinking in Java by Bruce Eckel (Fourth Edition)
3. "Java 8 in Action" by Raoul-Gabriel Urma, Mario Fusco, and Alan Mycroft
4. "Head First Java" by Kathy Sierra and Bert Bates

COURSE 07

Discipline/Programme	Computer Science
Semester	IV
Type of Course	DSC
Course Code	24UCAPDSC205
Course Title	**Advanced Web Technologies**
Course Level	200-299
Course Summary	Advanced Web Technologies course dives deeper than the fundamentals of web development, focusing on the latest tools and techniques for building complex and interactive web applications.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4
Pre-requisite, if any	Student should have basic knowledge in web technologies

COURSE OUTCOMES

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify and explain the functionalities of common PHP built-in functions (e.g., string manipulation, math functions)	Understand	PO1
2	Implement user-defined functions to modularize and improve code reusability.	Apply	PO1, PO2, PO6
3	Utilize appropriate data structures (arrays, objects) to effectively manage and manipulate data within PHP applications.	Analyse	PO1, PO6
4	Design and develop dynamic web applications with forms, user interaction, and database interaction using PHP and MySQL.	Create	PO1, PO6, PO7, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
	Introduction to PHP(10 hours)			
1	1.1	Introducing PHP – What is PHP? Why use PHP? Evolution of PHP, Creating your first script.	2	CO1
	1.2	PHP Language Basics – Using variables, Understanding Data Types, Operators and Expressions, Constants.	2	CO1
	1.3	Decisions and Loops – Making Decisions, Doing Repetitive Tasks with Looping, Mixing Decisions and Looping with HTML.	2	CO1
	1.4	Strings – Creating and Accessing Strings, Searching Strings, Replacing Text with Strings, Dealing with Upper and Lowercase, Formatting Strings	2	CO1
	1.5	Arrays – Creating Arrays, Accessing Array Elements, Looping Through Arrays with for-each, Working with Multidimensional Arrays, Manipulating Arrays.	2	CO1
	Concepts of Functions(16 hours)			
2	2.1	Functions – What is a Function? Why Functions are useful? Calling Functions.	2	CO2
	2.2	Working with Variable Functions, Writing your own Functions,	2	CO2
	2.3	Working with References, Writing Recursive Functions.	2	CO2
	2.4	Objects – Introduction OOP Concepts, Creating Classes and Objects in PHP,	2	CO2
	2.5	Creating and using Properties, Working with Methods, Object Overloading with _get(), _set() and _call(),	2	CO2
	2.6	Using Inheritance to Extend Power of Objects	2	CO2
	2.7	Constructors and Destructors	2	CO2
	2.8	Automatically Loading Class Files, Storing as Strings.	2	CO2

		Form Handling in PHP(6 hours)		
3	3.1	Handling HTML Forms with PHP – How HTML form works	2	CO3
	3.2	Capturing Form Data with PHP, Dealing with Multi-Value Fields	1	CO3
	3.3	Generating Web Forms with PHP,Storing PHP Variables in Forms	2	CO3
	3.4	Creating File Upload Forms, Redirecting After a Form Submission	1	CO3
	Working with files and Directories(13 hours)			
4	4.1	Getting Information on Files, Opening and Closing Files	2	CO4
	4.2	Reading and Writing to Files, Copying, Renaming, and Deleting Files, Working with Directories.	1	CO4
	4.3	Introducing Databases and SQL – Deciding How to Store Data,	2	CO4
	4.4	Understanding Relational Databases, Setting Up MySQL, A Quick Play with MySQL, Connecting MySQL from PHP.	2	CO4
	4.5	Retrieving Data from MySQL with PHP – Setting Up the Book Club Database	2	CO4
	4.6	Retrieving Data with SELECT, Creating a Member Record Viewer. Manipulating MySQL Data with PHP – Inserting, Updating, and Deleting Records,	2	CO4
	4.7	Building a Member Registration Application.	2	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Peer Teaching, Discussion-based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, Laboratory record, Any other method as may be required for specific courses by the course faculty.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, Any other method as may be required for specific courses by the course faculty.

References:

1. Matt Doyle, Beginning PHP 5.3 (Wrox – WileyPublishing)
2. Ellie Quigley, PHP and MySQL by Example
3. Joel Murach, Ray Harris, Murach's PHP and MySQL
4. Brett McLaughlin, PHP & MySQL: The Missing Manual
5. Luke Welling, Laura Thomson, PHP and MySQL Web Development
6. W. Jason Gilmore, Beginning PHP and MySQL from Novice to Professional

COURSE 8

Discipline/Programme	Computer Science
Semester	IV
Type of Course	DSC
Course Code	24UCAPDSC206
Course Title	**Operating System**
Course Level	200-299
Course Summary	This course is the foundation of Computer Science and essential for software development, networking and architecture. It covers a fundamental overview of the operating system and the major components.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Illustrate the creation and working of a process, threads and the execution of these in single-processor and multi-processor systems.	Analyse	PO1, PO2
2	Discuss issues of Memory management and Process Management including process structure, synchronization, scheduling and communication.	Apply	PO1, PO2
3	Interpret the reasons for deadlock state, and the solution methods to handle deadlock.	Analyse	PO1, PO2
4	Analyse the various device and resource management techniques in time sharing and distributed systems	Analyse	PO1, PO2
5	Appreciate the need of access control and protection in an operating system.	Understand	PO2, PO6, PO7, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
	Introduction to Operating System(16 hours)			
1	1.1	Introduction, Definition, Objectives and Functions of OS, OS Structures, OS Services, System calls	4	CO1
	1.2	Types of operating system- Batch Processing, Multiprogramming, Multiprocessing, Time Sharing, Distributed OS, Real time Processing. System calls, Types of System call	4	CO1
	1.3	Process: Basic Concepts, Operations on Processes, Inter process communication	4	CO1
	1.4	Threads: Introduction to Threads, Single and Multithreaded processes, User and Kernel threads, Multithreading models, Threading issues.	4	CO1
	Concepts of CPU Scheduling and Process synchronization(14 Hours)			
2	2.1	CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling Algorithms, Multiple Processor Scheduling.	4	CO2
	2.2	Process Synchronization: Mutual Exclusion, Critical – section problem, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical Regions, Monitors,	5	CO2
	2.3	Deadlocks: System Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	5	CO3
	Memory and Virtual Management(12 hours)			
3	3.1	Memory Management: Logical and physical Address Space, Swapping, Contiguous Memory Allocation, Paging, Segmentation with Paging.	6	CO2
	3.2	Virtual Management: Demand paging, Page Replacement Algorithms- FIFO, Optimal page replacement algorithm, LRU, Allocation of Frames, Thrashing,	6	CO2

	File System and Disk Management(18 hours)			
4	4.1	File-System Interface: File concept, Access Methods, Directory structure, File-System Implementation: File-System structure, File-System Implementations, Directory Implementation, Allocation Methods	6	CO4
	4.2	Disk Management: Disk Structure, Disk Scheduling-FCFS, SSTF, C Scan, Look, C-Look Disk Management	6	CO4
	4.3	Protection: Goals of Protection, Domain of Protection Access Matrix, implementation of access matrix. Security Security Problem, User Authentication, One – Tim Password, Program Threats, System Threats	6	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method may be required for a specific course by the course faculty*. **Practical:** *Observation of practical skills, Laboratory record, Any other method as may be required for specific courses by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific courses by the course faculty.*

References:

1. Milan Milonkovic, Operating System Concepts and Design, 2nd Edition.
2. Tanenbaum, Operating System Concepts, 2nd Edition, Pearson Education
3. Silberschatz Galvin Gagne, Operating System, 6th Edition WSE WILEY Publication
4. William Stallings, Operating System, 4th Edition, Pearson Education.

COURSE 09

Discipline/Programme	Computer Science
Semester	V
Type of Course	DSC
Course Code	24UCAPDSC301
Course Title	**Python for Data Science**
Course Level	300-399
Course Summary	This course equipped the students with the foundational tools for data analysis in Python. students gain in depth knowledge in numPy, pandas libraries and learn to leverage Pandas for basic plots and Seaborn for high-level statistical graphics like histograms, scatter plots, and heatmaps.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4
Prerequisite, if any	Basic Python

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Interpret the basic principles of Python programming language	Understand	PO1, PO6
2	Articulate the object-oriented programming concepts used in python	Understand	PO1, PO2
3	Identify the commonly used operations involving file systems	Analyse	PO1, PO2
4	Acquire the basic skill in data visualization using pandas, matplotlib, and seaborn	Analyse	PO8, PO2,PO3

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Python language basics (9 hours)			
	1.1	Definition of data, kinds of data, Data analysis, Significance of Python for Data Analysis, Essential Python Libraries, IPython and Jupyter, SciPy, scikit-learn, The Python Interpreter Running the IPython Shell, Running the Jupyter Notebook Tab Completion Introspection,	3	CO1
	1.2	The Python Interpreter Language Semantics, Indentation, not braces, Comments, Function and object method calls, Variables and argument passing, Dynamic references, strong types, Attributes and methods, Duck typing, Imports, Binary operators and comparisons, Mutable and immutable objects	2	CO1
	1.3	Scalar Types, Numeric types, Strings, Bytes and Unicode, Booleans, Type casting, None, Date and time	2	CO1
	1.4	if, elif, and else, for loops, while loops, pass, range	2	CO1
2	Data structures, Functions and NumPy Basics(10 hours)			
	2.1	Data Structures and Sequences- Tuple, Unpacking tuples, Tuple methods List, Adding and removing elements, Concatenating and combining lists, Sorting, Slicing, Dictionary, SetBuilt-In Sequence Functions	3	CO2
	2.2	Functions, Namespaces, Scope, and Local Functions, Returning Multiple Values, Functions Are Objects, Lambda Functions, Errors and Exception Handling, Exceptions in IPython, Files and the Operating System	3	CO2
	2.3	The NumPy ndarray: A Multidimensional Array Object, Pseudo random Number, Generation Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays	2	CO2
	2.4	Expressing Conditional Logic as Array Operations, File Input and Output with Arrays, Linear Algebra	2	CO2
3	Pandas Basics (14 hours)			
	3.1	Series, data frame, index Essential Functionality- re indexing, Dropping Entries from an Axis, Indexing, Selection, and Filtering, sorting, indexing, Axis Indexes with Duplicate Labels	3	CO3
	3.2	Summarizing and Computing Descriptive Statistics - summary statistics and related methods. Correlation and Covariance Unique Values, Value Counts, and Membership	3	CO3

	3.3	Data cleaning and preparation-handling missing data, Filtering Out Missing Data, Filling in Missing Data, Data Transformation. String Manipulation-Python Built-In String Object Methods, String Functions in pandas.	4	CO3
	3.4	Operations on CSV files. loading, Reading, writing Manipulating, and Processing Data, Hierarchical Indexing, Reshaping and Pivoting, Combining and Merging Datasets	4	CO3
4	Data Visualization (12 hours)			
	4.1	Purpose of Python Data Visualization , Introduction to matplot, Different Types of Plots in Matplotlib, Advantages and Disadvantages of using Matplotlib	3	CO4
	4.2	Introduction to seaborn, Overview of seaborn plotting functions, Different categories of plot in Seaborn, basic plots using seaborn	3	CO4
	4.3	Figures and Subplots Colors, Markers, and Line Styles, Ticks, Labels and Legends. Annotations and Drawing on a Subplot, Saving Plots to File	3	CO4
	4.4	Plotting with pandas and seabornLine PlotsHistograms and Density Plots, Bar PlotsScatter or Point PlotsFacet Grids and Categorical Data	3	CO4

Practicals(30 Hrs):

- Programs using list, dictionary, set, tuple
- Arrays and matrix using NumPy
- Data manipulations (data series and data frames) using Pandas
- Operations on csv files, cleaning and preparation of data using pandas
- Plotting and Visualization using Matplotlib, seaborn (Line, bar chart, pie chart, histogram, scatter plot etc..).

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:**

	Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. "Python for Data Analysis Data Wrangling with Pandas, NumPy, and Jupyter", by Wes McKinney 2022
2. "Python Data Science Handbook" by Jake VanderPlas 2022

COURSE 10

Discipline/Programme	Computer Science
Semester	V
Type of Course	DSC
Course Code	24UCAPDSC302
Course Title	**Computer Networks**
Course Level	300-399
Course Summary	Learn the basics of computer networking, the various protocols, to acquire networking skills and its troubleshooting.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Design a network or network topologies using the various network devices and the reference models with OSI, TCP/IP.	Understand	PO 1, PO 3
2	Select protocols from application layer protocols, transport layer protocols and network layer protocols to implement the network and its switching.	Apply	PO 2, PO 4
3	Discuss the data transmission techniques in the networks with its control flow and error correction strategies.	Analyse	PO 1, PO 4
4	Explain wireless communication networks, devices, security protocols and its generations	Understand	PO 6, PO 3

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Communication(11 Hours)			
	1.1	Introduction to Communication: Basics of Network & Networking, Advantages of Networking.	2	CO1
	1.2	LAN, MAN, WAN, Network Terms: Host, Workstations, Server; Client; Node; Types of Network Architecture: Peer-to-Peer & Client/Server; Workgroup Vs. Domain;	2	CO1
	1.3	Network Devices- NIC- Functions of NIC, Hub, Switch, Bridge, Router, Gateways, And Other Networking Device, and Modem;	2	CO1
	1.4	Network Topologies: Types of Topologies, Logical and physical topologies, Selecting the Right Topology;	2	CO1
	1.5	Models of Network Introduction of OSI model, Seven layers of OSI model, Functions of the seven layers, Introduction of TCP/IP Model, Comparison between OSI model & TCP/IP model.	3	CO1
2	Multiplexing, Switching Techniques and different Protocols(15 Hours)			
	2.1	Multiplexing: FDM, TDM, WDM, SONET.	2	CO2
	2.2	Switching techniques: Packet switching, Structure of packet switching, Circuit switching.	4	CO2
	2.3	Transport protocols: TCP, UDP	3	CO2
	2.4	Network layer Protocols: IPv4, IPv6, ICMPV4, ICMPV6, IGMP, ARP, RARP, DHCP	3	CO2
	2.5	Protocols: HTTP/HTTPS, FTP, TFTP, SFTP, Telnet; Email: SMTP, POP3/IMAP. Point-to-Point Protocol (PPP), PPP standards	3	CO2
	Basic Concepts of Network(14 Hours)			
	3.1	Basics of Network, Transport and Application Layer protocols	1	CO2

3	3.2	Framing: fixed size framing; variable size framing Routing algorithms: Shortest Path (Bellman Ford Algorithm) Dijkstras' algorithm.	3	CO3
	3.3	Flow Control: Noiseless Channel Protocol: simplest protocol, stop and wait protocol. Noisy channel protocol: Stop and wait ARQ, Goback N ARQ, selective repeat ARQ, piggy backing.	2	CO3
	3.4	Error detection and correction: Types of errors; Redundancy- detection and correction. Parity check; polynomial codes Hamming distance – minimum Hamming distance.	4	CO3
	3.5	Congestion control algorithms: Leaky bucket algorithm; Token bucket algorithm.	2	CO3
	3.6	Network Utilities commands: ping, traceroute, tracert, ipconfig, arp, nslookup, netstat, nbtstat; Hardware TroubleShooting Tools, System Monitoring Tools.	2	CO3
4	Wireless Network and its components(20 Hours)			
	4.1	WAN Technology File-System Implementations, Directory Implementation, Allocation Methods, Digital representation of information: properties of signals, Transmission modes: parallel and serial transmission.	4	CO4
	4.2	PSTN, ISDN, DSL, CATV, Satellite-Based Services, Types of Wireless Networks: Ad-hoc mode; Infrastructure mode;	5	CO4
	4.3	Wireless network Components: Wireless Access Points Wireless NICs; Wireless LAN standards: IEEE 802.11a IEEE 802.11b, IEEE 802.11g, wireless LAN modulation techniques	4	CO4
	4.4	Wireless security Protocols: WEP, WPA, 802.1X Connecting to the Internet	4	CO4
	4.5	Cellular Technologies: 2G;3G;4G;5G	3	CO4

Practical (30Hrs):

- Create Network topologies.
- 2. Basic configuration of network devices.
- 3. IP calculation and subnetting.
- 4. Implementation of routing algorithms.
- 5. Network troubleshooting.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method may be required for a specific course by the course faculty*. **Practical:** *Observation of practical skills , Laboratory record, Any other method as may be required for specific courses by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty*.

References:

1. Andrew s. Tanenbaum; David j. Wetherall; Computer Networks; fifth edition; Pearson Publications 2011
2. CCNA (2011), Cisco Certified Network Associate: Study Guide (With CD) ; 5th Edition
3. CCENT/CCNA ICND1 (2013), Official Cert Guide; 3rd Edition (Paperback)
4. CCNA (2008), Routing Protocols and Concepts CCNA Exploration Companion Guide (With CD) (Paperback); Pearson
5. CCNA (2010), Exploration Course Booklet Routing Protocols and Concepts Version 4.0 (Paperback), Pearson

COURSE 11

Discipline/Programme	Computer Science
Semester	V
Type of Course	DSC
Course Code	24UCAPDSC303
Course Title	**Software Engineering**
Course Level	300-399
Course Summary	Learn the scientific way of software engineering models. This course imparts knowledge of designing, coding, testing, debugging and software applications.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Illustrate the characteristics of software engineering and the life cycle model.	Understand	PO1, PO8
2	Apply the concept of software requirement analysis and planning to develop software systems for real world problems.	Apply	PO1, PO2, PO4, PO6, PO8
3	Design a software design by considering the aspects of heuristics, modularity, uml.	Apply	PO1,PO3
4	Differentiate between the types of software testing methodologies.	Analyse	PO1,PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Software Engineering (16 hours)			
	1.1	Introduction to Software Engineering, Software Engineering Paradigm ,Verification and validation	4	CO1
	1.2	Life cycle Models	4	CO1
	1.3	Software Engineering Vs System Engineering	4	CO1
	1.4	Overview of Product Engineering	4	CO1
2	Software Requirements(14 hours)			
	2.1	Introduction to Software Requirements, Functional and Non-functional requirements, Software Document, Software Requirement Specification	6	CO2
	2.2	Requirement Engineering process, Feasibility study, project plan: Gantt chart, pert chart	3	CO2
	2.3	Software prototyping	3	CO2
	2.4	Functional and behavioral models, Data Dictionary	2	CO2
3	Software Design(16 hours)			
	3.1	Analysis Concepts	2	CO3
	3.2	Design Process and Concepts	4	CO3
	3.3	Modular Design, Design Heuristics	4	CO3
	3.4	User interface design	4	CO3
	3.5	DFD, UML diagrams: Use case diagram, Activity diagram, sequence diagram, object diagram, class diagram	4	CO3
	Software Testing(14 hours)			
4	4.1	Taxonomy of Software Testing, Types of Software Testing	4	CO4
	4.2	Black Box Testing	4	CO4

	4.3	White Box Testing	4	CO4
	4.4	System Testing and Debugging	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References :

1. Ian Sommerville (2007), Software engineering 7th Edition, Pearson Education Asia.
2. Roger S. Pressman (2005), Software Engineering A Practitioner Approach, 6th Edition

COURSE 12

Discipline/Programme	Computer Science
Semester	VI
Type of Course	DSC
Course Code	24UCAPDSC304
Course Title	**Machine Learning**
Course Level	300-399
Course Summary	This course provides a broad introduction and basic theory underlying machine learning and covers the techniques on how to make learning by a model, how it can be evaluated and different algorithms to construct a learning model.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
CO1	Identify the life cycle of ML and its types	Understand	PO1
CO2	Learn the various classification algorithms used in supervised learning.	Understand	PO1, PO2, PO3
CO3	Explain various clustering algorithms and dimensionality reduction techniques used in unsupervised learning	Understand	PO1, PO2
CO4	Analyze the performance of machine learning models using evaluation metrics like accuracy, precision, and recall.	Analyse	PO2, PO3, PO6

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	Introduction to Machine Learning(12 hours)			
	1.1	Definition and applications of Machine Learning	4	CO1
	1.2	Types of ML algorithms and their uses	4	CO1
	1.3	Machine Learning lifecycle and process	4	CO1
2.	Supervised Learning(11 hours)			
	2.1	Introduction to supervised learning	3	CO2
	2.2	Regression algorithms - linear regression, polynomial regression	4	CO2
	2.3	Classification algorithms - decision trees, logistic regression, support vector machines	4	CO2
3.	Unsupervised Learning(11 hours)			
	3.1	Introduction to unsupervised learning	4	CO3
	3.2	Clustering algorithms - k-means clustering, hierarchical clustering	3	CO3
	3.3	Dimensionality reduction techniques - principal component analysis, t-SNE	4	CO3
4.	Model Evaluation and Validation(11 hours)			
	4.1	Techniques for evaluating ML models	2	CO4
	4.2	Cross-validation and train-test splits	3	CO4
	4.3	Performance metrics - accuracy, precision, recall, F1 score	3	CO4
	4.4	Feature Engineering and Selection - Preprocessing and cleaning of data	3	CO4

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Theory:
Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. Any other method as may be required for specific course by the course faculty.
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Theory:
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Practical:
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</table>

References:

1. Murphy, K. P. (2021). Probabilistic Machine Learning: An Introduction (2nd ed.). MIT Press.
2. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An Introduction to Statistical Learning with Applications in R (2nd ed.). Springer.
3. Géron, A. (2023). Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (3rd ed.). O'Reilly Media.

Additional References:

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
2. Goldberg, Y. (2021). A Primer on Neural Network Models for Natural Language Processing. John Wiley & Sons.

COURSE 13

Discipline/Programme	Computer Science
Semester	VI
Type of Course	DSC
Course Code	24UCAPDSC305
Course Title	**Software Development**
Course Level	300-399
Course Summary	This course focuses on developing a plan for a software project, creating test cases, reengineering software, preparing and implementing change requests, and developing high-quality software.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
CO1	Illustrate the concepts of developing software projects.	Understand	PO1, PO2
CO2	Analyse and develop test cases and Software Requirement Specification	Analyse, Apply	PO1, PO2
CO3	Design Document and Testing	Analyse, Apply	PO1, PO2 ,PO8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Description	Hours	CO No.
	Introduction (30 hours)			
1.	1.1	Introduction to Software Development - Overview of Software Development Life Cycle (SDLC)	6	**CO1**
	1.2	Software Project Management- Project Planning, Activities and milestones, Resource requirements and scheduling, Managing project timeline and adjustments.	8	**CO1**
	1.3	Working with Requirements - Feasibility Report, Gathering requirements.	8	**CO2**
	1.4	Software Requirement Specifications – Creating SRS documents	8	**CO2**
	Design Document and Testing(30 hours)			
2.	2.1	Design Document - Architecture design, data design, Interface design, procedural design	8	**CO3**
	2.2	Software Testing – Writing Test Plans and Test cases , Performing testing (Manual vs Automated testing)	8	**CO3**
	2.3	Implementation- Coding best practices - validation checks, error and exception handling	8	**CO3**
	2.4	List of Problems and Summary – Identifying common pitfalls in design, coding and testing, Overcoming common software development problems.	6	**CO3**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study

	report/Group discussion. *Any other method may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill, 7th edition, 2010.
2. R. Fairley, "Software Engineering Concepts", Tata McGraw Hill Edition -1997.
3. Jack T.Marchewka, "Information Technology and Project Management",John Wiley & sons P.Ltd, 2003.

COURSE 14

Discipline/Programme	Computer Science
Semester	VI
Type of Course	DSC
Course Code	24UCAPDSC306
Course Title	**Data Mining**
Course Level	300-399
Course Summary	This course explores data warehousing concepts, data mining techniques for knowledge discovery, and various classification and clustering methods for business analysis.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain Data warehouse architecture and its Implementation	Understand	PO1, PO8
2	Analyse Architecture of a Data Mining system.	Apply	PO1, PO8
3	Apply Data preprocessing Methods	Create	PO1, PO2
4	Perform classification and prediction of data	Create	PO1, PO2,PO6

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Data Warehousing and Business Analysis (13 hours)			
	1.1	Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture	2	CO1
	1.2	DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications	2	CO1
	1.3	Trends in Data Warehouse, Introduction to Data Warehousing, Evolution of Data Warehousing, Data Warehousing Concepts	2	CO1
	1.4	Online Transaction Processing Systems, Characteristics of Data Warehouse, Data Granularity	2	CO1
	1.5	Metadata and Data Warehousing, Functionality of Data Warehouse	2	CO1
	1.6	Advantages of Data warehouse, Applications of Data Warehouse, Concerns in Data Warehouse, Types of Data Warehouses	1	CO1
	1.7	Introduction to Online Analytical Processing	1	CO1
	1.8	Need for OLAP, Characteristics of OLAP, OLAP and Multidimensional Analysis, Multidimensional Logical Data, Model and its Users, OLAP Functions	1	CO1
2	Data Mining(12 hours)			
	2.1	Data Mining: Applications of Data Mining, Data Mining Tools, Major Issues in Data	4	CO2

		Mining		
	2.2	Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation	4	CO2
	2.3	Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods ,Apriori and FP growth– Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.	4	CO2
3	Classification and Prediction(10 hours)			
	3.1	Introduction to Classification and Prediction - Issues Regarding Classification and Prediction	2	CO4
	3.2	Classification by Decision Tree Introduction	2	CO4
	3.3	Bayesian Classification – Rule Based Classification	2	CO4
	3.4	Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods	2	CO4
	3.5	Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor	2	CO4
4	Overview of Cluster Analysis(10 hours)			
	4.1	Cluster Analysis: - Types of Data in Cluster Analysis	2	CO3
	4.2	A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods	2	CO3
	4.3	Density-Based Methods – Grid-Based Methods – Model-Based Clustering	2	CO3

	4.4	Methods – Clustering High-Dimensional Data	2	CO3
	4.5	Constraint-Based Cluster Analysis – Outlier Analysis.	2	CO3
5	Teacher specific course components			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, Laboratory record, Any other method as may be required for specific courses by the course faculty.*
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References:

1. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.
2. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”,

Tata McGraw – Hill Edition, Tenth Reprint 2007.
3. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
4. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.

COURSE 15

Discipline/Programme	Computer Science
Semester	VII
Type of Course	DSC
Course Code	24UCAPDSC401
Course Title	**Research Methodology**
Course Level	400-499
Course Summary	This course helps students to understand the issues involved in selecting a research problem, and the techniques and tools needed in the research.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOME

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the basics of research methodology and how to apply them to research projects	Understand	PO1, PO4, PO8
2	Develop advanced critical thinking skills and select appropriate method for data collection	Apply	PO1, PO2, PO7
3	Perform data analysis in qualitative and quantitative manner	Create	PO1, PO2, PO8
4	Develop enhanced writing skills	Create	PO1, PO2, PO4, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to concepts of Research(16 hours)			
	1.1	Meaning and importance of Research	3	CO1
	1.2	Types of Research and Approaches, Selection and Formulation of Research Problem- Research Design	3	CO1

	1.3	Ethics in Research and Plagiarism	3	CO1
	1.4	Types and Methods of Research: Different Patterns of Research: Inductive and Deductive, Comparison & Contrast, Spatial, Chronological, Cause & Effect.	3	CO1
	1.5	Quantitative and Qualitative Approach	2	CO1
	1.6	Collection of Information and Evaluation	2	CO1
2	Material Collection and Analysis(14 hours)			
	2.1	Objectives and Classification, Primary and Secondary sources	3	CO2
	2.2	Different methods of data collection: Observation, Questionnaire, Interview etc.	3	CO2
	2.3	Scaling Techniques- different types of scales	4	CO2
	2.4	Sampling- Different types- Sampling Errors, Different types of variables.	4	CO2
3	Data Analysis and Interpretation(12 hours)			
	3.1	Classification and Tabulation of data	4	CO3
	3.2	Descriptive analysis: Central Tendency and Dispersion, Coefficient of variation, Correlation and Regression Analysis	4	CO3
	3.3	Analysis of Data: Different approaches, Testing of Hypothesis	4	CO3
4	Report Writing and Project Proposal(18 hours)			
	4.1	Organization of Research Report	5	CO4
	4.2	Types of Research report, structure and components	5	CO4
	4.3	Style Manuals	4	CO4
	4.4	Evaluation of Research Report	1	CO4
	4.5	Preparation of Project proposal, Application of Computer in Research	3	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

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</table>

References:

1. Garg B. L Karadia R, Agarwal, F and Agarwal, Introduction to Research Methodology
2. Kothari C. R. Research Methodology: Methods and Techniques
3. Sinha S.C and Dhiman A. K, Research Methodology
4. Wilcox R. Rand, Fundamentals of Modern Statistics Methods

COURSE 16

Discipline/Programme	Computer Science
Semester	VII
Type of Course	DSC
Course Code	24UCAPDSC402
Course Title	**Software Testing Methodologies**
Course Level	400-499
Course Summary	This course delves into the world of software testing, equipping you with the strategies and techniques to ensure software functions flawlessly.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Gain a comprehensive understanding of software testing fundamentals and objectives.	Understand	PO1
2	Master different software testing methodologies and their applications.	Apply	PO1, PO2
3	Develop expertise in applying testing techniques for different testing levels (unit, integration, system).	Apply	PO2
4	Effectively report and communicate testing results.	Analyse	PO3, PO7

COURSE CONTENT

Module	Units	Description	Hrs	CO
Introduction to Software Testing(7 Hours)				
1	1.1	Software Development Life Cycle (SDLC) and the role of testing within it.	3	CO1
	1.2	Testing principles: Defect prevention vs. defect detection. Types of software testing (functional, non-functional, black-box vs. white-box). Testing challenges and best practices.	4	CO1
Software Testing Techniques(11 Hours)				
2	2.1	Black-box testing techniques (equivalence partitioning, boundary value analysis, exploratory testing).	4	CO1
	2.2	White-box testing techniques (unit testing, code coverage, code reviews).	3	CO1
	2.3	Agile testing methodologies and practices (test-driven development, continuous integration/continuous delivery). Performance testing: concepts, types (load, stress, scalability), and tools (e.g., JMeter, LoadRunner).	4	CO2
Test Plan and Test Case Design(12 hours)				
3	3.1	Designing effective test plans, considering different testing levels and functionalities..	4	CO2
	3.2	Test case design techniques (equivalence partitioning, boundary value analysis, decision tables).	4	CO2
	3.3	Test estimation and scheduling for efficient testing execution. Defect management tools and processes for tracking and resolving issues (e.g., Bugzilla, Jira).	4	CO2
Working with Test cases(15 Hours)				
4	4.1	Script development using programming languages (e.g., Java, Python) to automate test cases.	3	CO3
	4.2	Locating elements on web pages (id, XPath, accessibility ID). Handling web page interactions (clicks, form submissions, browser navigation).	4	CO3

		Integrating with testing frameworks (e.g., JUnit, TestNG).		
	4.3	Creating comprehensive test reports with clear and concise information using tools (e.g., TestNG reports, JUnit reports).	4	CO4
	4.4	Effectively communicating testing results to developers, project managers, and stakeholders.	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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References

1. "Performance Testing: A Practical Guide to Load Testing and Capacity Planning" by Vincent Munson.
2. "Black Box Testing: Techniques for System and Software Testing" by Boris Beizer
3. The craft of Software Testing- Brian Marick, Pearson Education
4. Software Testing in the Real World- Edward Kit, Pearson

COURSE 17

Discipline/Programme	Computer Science
Semester	VII
Type of Course	DSC
Course Code	24UCAPDSC403
Course Title	**Design and Analysis of Algorithms**
Course Level	400 - 499
Course Summary	Learn algorithm designing and evaluation and analysis.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain various designing techniques and methods for algorithms.	Understand	PO1, PO2
2	Performance analysis of Algorithms using asymptotic and empirical approaches.	Analize	PO2
3	Demonstrate a familiarity with major algorithms and data structures.	Analize	PO5, PO8
4	Draw insights on algorithmic design paradigms like Divide-and-Conquer, Dynamic Programming, Greedy, Branch and Bound etc.	Apply	PO6, PO7

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	Introduction to Design and Analysis of algorithm(13 Hours)			
	1.1	Algorithm, pseudo code for expressing algorithms,	3	CO2
	1.2	performance analysis-space complexity	3	CO2
	1.3	time complexity, asymptotic notation- big (O) notation, omega notation, theta notation and little (o) notation	3	CO2
	1.4	Recurrences	2	CO1
	1.5	probabilistic analysis	1	CO3
	1.6	disjoint set operations, /union and find algorithms.	1	CO2
2.	Working with searching and sorting Techniques(12 Hours)			
	2.1	General method, applications-analysis of binary search	2	CO3
	2.2	Quick sort	1	CO1
	2.3	Merge sort	1	CO1
	2.4	AND OR Graphs	1	CO1
	2.5	GREEDY METHOD: General method, Applications-job sequencing with deadlines	2	CO4
	2.6	Fractional knapsack problem	1	CO4

	2.7	minimum cost spanning trees	2	CO3
	2.8	Single source shortest path problem.	2	CO2
3.	Traversal Techniques and Dynamic Programming(15 hours)			
	3.1	Breadth first search and traversal	2	CO3
	3.2	Depth first search and traversal, Spanning trees	2	CO3
	3.3	Connected components and bi-connected components, Articulation points	2	CO3
	3.4	DYNAMIC PROGRAMMING: General method, applications - optimal binary search trees	3	CO3
	3.5	0/1 knapsack problem	1	CO3
	3.6	All pairs shortest path problem	2	CO2
	3.7	Travelling salesperson problem, Reliability design.	3	CO2
4.	Backtracking(13 Hours)			
	4.1	General method, Applications- n-queen problem	3	CO4
	4.2	Sum of subsets problem, Graph coloring and Hamiltonian cycles	3	CO4
	4.3	BRANCH AND BOUND: General method, applications - travelling salesperson problem	2	CO4

	4.4	0/1 knapsack problem- LC branch and bound solution, FIFO branch and bound solution.	3	CO2
	4.5	Applications of evolutionary algorithms in engineering design, scheduling, and data mining	2	CO2
5.	V NP-HARD AND NP-complete problems(7 Hours)			
	5.1	V NP-HARD AND NP-COMPLETE PROBLEMS: Basic concepts, non-deterministic algorithms	4	CO2
	5.2	NP-hard and NP-complete classes, Cook‘s theorem.	3	CO1

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Ellis Horowitz, Satraj Sahni, Rajasekharam (2007), Fundamentals of Computer Algorithms, 2nd edition, University Press, New Delhi.
2. R. C. T. Lee, S. S. Tseng, R.C. Chang and T. Tsai (2006), Introduction to Design and Analysis of Algorithms A strategic approach, McGraw Hill, India.
3. Allen Weiss (2009), Data structures and Algorithm Analysis in C++, 2nd edition, Pearson education, New Delhi.
4. Aho, Ullman, Hopcroft (2009), Design and Analysis of algorithms, 2nd edition, Pearson education, New Delhi.

Additional References:

1. "Fundamental of Algorithms", by Gills Brassard, PaulBratley, PHI.
2. "Design and Analysis of Computer Algorithms", by Aho, Hopcroft and Ullman, Pearson
3. The Algorithm Design Manual, by Steve s. Skiena

COURSE 18

Discipline/Programme	Computer Science
Semester	VII
Type of Course	DSC
Course Code	24UCAPDSC404
Course Title	**Artificial Intelligence**
Course Level	400-499
Course Summary	This course allows students to introduce the basic principles, techniques and applications of Artificial Intelligence. It also helps to develop the AI skills for designing and analysing AI based algorithms.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the evolution, category, applications, key concepts and methodologies.	Understand	PO7, PO8
2	Identify the problem-solving techniques and heuristics search techniques.	Apply	PO1, PO2, PO6
3	Explain knowledge representation, its techniques and reasoning.	Understand	PO1, PO2, PO6
4	Explain the planning process and its different types.	Understand	PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	Introduction to AI(11 hours)			
	1.1	Evolution of AI	2	CO1
	1.2	Turing Machine, Turing test	3	CO1
	1.3	Category of AI, Applications of AI	3	CO1
	1.4	Key AI concepts and methodologies	3	CO1
2.	Problem Solving(10 hours)			
	2.1	Problem-solving techniques and strategies	3	CO2
	2.2	Solving problems by searching	3	CO2
	2.3	Heuristic search techniques, Best first search, mean and end analysis, A*, Game Playing.	4	CO2
3.	Knowledge Representation and Reasoning(12 hours)			
	3.1	Knowledge representation techniques: predicate logic, semantic networks	4	CO3
	3.2	Rule-based reasoning and expert systems	4	CO3
	3.3	Common-sense reasoning	4	CO3
4.	Heuristics Planning(12 hours)			
	4.1	Classical Planning, Heuristics for Planning, Hierarchical Planning	4	CO4
	4.2	Planning and Acting in Nondeterministic Domains	4	CO4
	4.3	Representing temporal and resource constraints	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson Education.
2. Poole, D. L., & Mackworth, A. K. (2022). Artificial Intelligence: Foundations of Computational Agents (3rd ed.). Cambridge University Press.
3. Luger, G. F. (2021). Artificial Intelligence: Structures and Strategies for Complex Problem Solving (7th ed.). Pearson Education.

Additional References:

1. Nilsson, N. J. (2020). Artificial Intelligence: A New Synthesis (5th ed.). Morgan Kaufmann.
2. Stuart, R. (2020). Human-Compatible AI: Artificial Intelligence and the Problem of Control. Penguin Books.

COURSE 19

Discipline/Programme	Computer Science
Semester	VII
Type of Course	DSC
Course Code	24UCAPDSC405
Course Title	**Internet of Things**
Course Level	400-499
Course Summary	Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Analyse how connected devices work together	Understand	PO1,PO2
2	Acquire knowledge to interface sensors and actuator with microcontroller-based Arduino Platform	Understand	PO1,PO2
3	Build IoT based applications and understand the data flow between them.	Apply	PO1, PO2, PO7, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Fundamental IoT concepts (12 hours)			
	1.1	Introduction - Overview of Internet of Things (IoT), the characteristics of devices and applications in IoT ecosystem	3	CO1
	1.2	Building blocks of IoT, Various technologies making up IoT ecosystem, IoT levels	3	CO1
	1.3	IoT design methodology, The Physical Design/Logical Design of IoT.	3	CO1
	1.4	Functional blocks of IoT and Communication Models.	3	CO1
2	Communication protocols(12 hrs)			
	2.1	Working of Controlled Systems, Real-time systems with feedback loop e.g., thermostat in refrigerator, AC, etc.	4	CO1
	2.2	Connectivity models – TCP IP versus OSI model	4	CO1
	2.3	Different type of modes using wired and wireless methodology, the process flow of an IoT application	4	CO1
3	Interface sensors and actuator(13 hrs)			
	3.1	Sensor - Measuring physical quantities in the digital world e.g., light sensor, moisture sensor, temperature sensor, etc.	4	CO2
	3.2	Actuator – moving or controlling system e.g., DC motor. different types of actuators.	4	CO2
	3.3	Controller – Role of microcontroller as gateway to interfacing sensors and actuators, microcontroller vs microprocessor, different types of microcontrollers in embedded ecosystems.	5	CO2
	Programming with Embedded C(23 hrs)			

4	4.1	Interfacing Sensors, Functions and Practical Implementation: Building IoT applications: Embedded C Language basics, Standard Library of C functions in Arduino IDE.	5	CO3
	4.2	Prototype of a function: Formal parameter list, Return Type, Function call	4	CO3
	4.3	Interfacing sensors – The working of digital versus analog pins in Arduino platform, interfacing LED, Button, Sensors-DHT, LDR, MQ135.	5	CO3
	4.4	Display the data on Liquid Crystal Display (LCD), interfacing keypad, Serial communication.	4	CO3
	4.5	Interfacing HC-05(Bluetooth module) Control/handle 220v AC supply – interfacing relay module	5	CO3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **C. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
	D. End Semester Examination (ESE) **Theory:**

	Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Internet of Things: A Hands- on Approach
2. Internet of Things: Architecture and Design Principles
3. IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things

COURSE 20

Discipline/Programme	Computer Science
Semester	VII
Type of Course	DSC
Course Code	24UCAPDSC406
Course Title	**Big Data Analytics**
Course Level	400-499
Course Summary	This course is an introduction to large-scale data analytics. Big Data analytics is the study of how to extract actionable, non-trivial knowledge from a massive number of data sets. This course will focus both on the cluster computing software tools and programming techniques used by data scientists and the important mathematical and statistical models used in learning from large-scale data processing.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4
Pre-requisite, if any	Data Mining

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Solve the problems using MapReduce programming paradigm.	Apply	PO1, PO2
2	Apply spark libraries for solving distributed applications.	Apply	PO2
3	Analyze streaming data using Spark Streaming libraries.	Analyze	PO2
4	Demonstrate the usage of MongoDB, Hbase and Hive.	Apply	PO1, PO2

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Introduction to Big Data (11 hours)			
	1.1	Introduction to Big Data, Data life cycle	2	CO1
	1.2	Structuring Big Data, Characteristics of Big Data, Big data applications	2	CO1
	1.3	Technologies for handling big data, Distributed and Parallel Computing for Big Data	1	CO1
	1.4	Introducing Hadoop, Hadoop multi node cluster architecture	2	CO1
	1.5	Introduction to data lake, data cleansing and transformations	1	CO1
	1.6	Data lake reference architecture, HDFS and MapReduce, HDFS Concepts	1	CO1
	1.7	MapReduce Execution, Algorithms using MapReduce	1	CO1
	1.8	Limitations of Hadoop, Overcoming the limitations of Hadoop	1	CO1
2	Working with Apache Spark(10 hours)			
	2.1	Apache Spark- Ecosystem, Components of the Spark unified stack-Spark SQL	2	CO2
	2.2	Spark Streaming, Spark GraphX, Spark MLLib, Spark context	2	CO2
	2.3	spark stage, spark executor, Spark Architecture	1	CO2
	2.4	RDD and RDD Operations, RDD Features and limitations, RDD- Persistence and Cashing mechanism	2	CO2
	2.5	DAG, spark cluster management	1	CO2
	2.6	DataFrames and Dataset – In-memory distributed processing using Apache Spark, Spark shell commands	2	CO2
	Streaming Architectures(12 hours)			
	3.1	Streaming Data, Streaming Architectures - Lambda architecture, Kappa architecture	2	CO3
	3.2	Spark Streaming- Streaming system components	2	CO3

3	3.3	Discretized stream processing, Spark streaming architecture, Transformations on Dstreams	1	CO3
	3.4	Window operations, Join and output operations, Caching	1	CO3
	3.5	Checkpointing, Structured Streaming	1	CO3
	3.6	Managing Distributed Data Flow with Apache Kafka-Kafka Fundamentals	1	CO3
	3.7	Use case and applications, Architecture, Kafka Topics	1	CO3
	3.8	Producer and consumer-Producer and consumer configuration and execution	1	CO3
	3.9	In-Sync Replicas, Kafka Consumer groups	2	CO3
4	NoSQL and Types(12 hours)			
	4.1	NoSQL Databases	2	CO4
	4.2	Types NoSQL Databases	1	CO4
	4.3	Introduction to MongoDB, Data model design, CRUD operations on MongoDB	2	CO4
	4.4	Projection, limiting and sorting records, indexing, Aggregation, replication and sharding, Analyzing queries	1	CO4
	4.5	Introduction to Hbase, HBase data model regions	1	CO4
	4.6	HBase Architecture, zookeeper,Dataflow, WAL and Memstore	1	CO4
	4.7	HFile, CRUD operations, Meta table, Merge and compaction	1	CO4
	4.8	Introduction to Hive, Hive data types, Hive file formats,Hive database and table operations, partitioning	2	CO4
	4.9	Built in operators and functions, Views and indexes, Spark on Hive.	1	CO4

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.</td></tr>
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A. Continuous Comprehensive Assessment (CCA)
Theory:
Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. Any other method as may be required for specific course by the course faculty.
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Practical:
Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.</td></tr>
</table>

References:

1. Bill Chambers AndMateiZaharia, “Spark: The Definitive Guide: Big Data Processing Made Simple”, O'Reilly Media, 2018
2. Tathagata Das, Jules S. Damji, Brooke Wenig, Denny Lee, “Learning Spark: LightningFast Data Analytics,” Second Edition, O’Reilly Media, 2020
3. DT Editorial Services,“Big Data, Black Book : Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization”, DreamTech Press, 2016
4. Natraj Dasgupta, “Practical Big Data Analytics”, Packt, 2018
5. Gerard Maas, Francois Garillot “Stream Processing with Apache Spark”, O'Reilly Media, 2019
6. Bart Baesens, “Analytics in Big Data World," Wiley, 2014
7. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
8. Kristina Chodorow and Michael Dirolf, “MongoDB: The Definitive Guide”,O'Reilly Media, 2019
9. Andy Konwinski, Holden Karau, MateiZaharia, and Patrick Wendell, “Learning Spark: LightningFast Big Data Analysis," O Reilly, 2015.

COURSE 21

Discipline/Programme	Computer Science
Semester	VIII
Type of Course	DSC
Course Code	24UCAPDSC407
Course Title	**Research and Publication Ethics**
Course Level	400-499
Course Summary	This course has a total of 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. This course is designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, and research metrics are also introduced.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO'S
1	Aware of publication ethics and misconducts	Understand	PO4, PO5, PO6
2	Developing skills to identify research misconduct and predatory publications	Apply	PO1, PO4, PO6
3	Differentiating indexing and citation databases, open access publications, and research metrics	Analyze	PO6
4	Acquiring knowledge and professional competence and expertise about patents, copyrights, and other forms of intellectual property right	Evaluate	PO4, PO6

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	Introduction to Philosophy and Ethics(15 hours)			
	1.1	Introduction to Philosophy, Definition, Nature and scope, concept branches	8	CO1
	1.2	Ethics: Definition, Moral Philosophy, Nature of moral judgements and reactions	7	CO1
2.	Scientific misconduct and Redundant Publications(15 hours)			
	2.1	Scientific Misconduct: Ethics with respect to Science and research, intellectual honesty and research integrity, Scientific mis-conducts,: falsification, Fabrication and Plagiarism, Intellectual honesty and research integrity.	5	CO2
	2.2	Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)	5	CO2
	2.3	Redundant publications: duplicate and overlapping publications, salami slicing elective reporting and misrepresentation of data	5	CO2
3.	Publication Ethics and Open Access Publishing(17 hours)			
	3.1	Publication ethics: definition, introduction and importance Best practices/standards setting initiatives and guidelines: COPE, WAME etc.	4	CO3
	3.2	Conflicts of interest 4. Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributorship.	4	CO3
	3.3	Identification of publication misconduct, complaints and appeals, Predatory publishers and journals	5	CO3
	3.4	Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc	4	CO3
4.	Software Tools and Research Metrics(13 hours)			
	4.1	A. Group Discussions, subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad Software tools:Use of plagiarism software like Turnitin, Urkund and other open source software tools	6	CO4

	4.2	Databases Indexing databases Citation databases: Web of Science, Scopus etc. Research Metrics	3	CO4
	4.3	Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index, altmetrics.	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Garg.B.L.,Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes
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6. Hempel,C. Philosophy of Natural science Englewood Cliffs, N.J: Prentice Hall, 1966.
7. Burtt, E.A. The Metaphysical Foundations of Modern Science. London, 2003.
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9. Gupta S.P. (2008). Statistical Methods. 37th ed. (Rev)Sultan Chand and Sons. New Delhi. 1470 p.

COURSE 22

Discipline/Programme	Computer Science
Semester	VIII
Type of Course	DSC
Course Code	24UCAPDSC408
Course Title	**Deep Learning**
Course Level	400-499
Course Summary	This course aims to present the core fundamentals behind the Deep Learning area and enables them to gain adequate knowledge to apply the techniques in solving real world problems.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO'S
1	Explain the basic principles of deep learning and its applications in various domains.	Understand	PO1, PO2
2	Implement and train various deep learning models using popular libraries like TensorFlow and PyTorch.	Understand	PO1, PO2
3	Evaluate the performance of deep learning models and analyze their results.	Apply	PO2, PO6
4	Apply their understanding of deep learning to solve real-world problems.	Apply	PO3, PO5, PO8

COURSE CONTENTS

Module	Units	Description	Hrs	CO
1.	Foundations of Deep Learning(11 hours)			
	1.1	Introduction to deep learning - history, objectives, applications.	3	CO1
	1.2	Mathematical foundations - linear algebra, calculus, probability theory.	3	CO1
	1.3	Optimization algorithms - gradient descent, stochastic gradient descent, Adam.	3	CO1
	1.4	Loss functions - cross-entropy, mean squared error, binary cross-entropy.	2	CO1
2.	Deep Learning Architectures(11 hours)			
	2.1	Convolutional Neural Networks (CNNs) - architectures, convolutional layers, pooling layers, applications in computer vision.	3	CO2
	2.2	Recurrent Neural Networks (RNNs) - architectures, hidden states, long short-term memory (LSTM), gated recurrent units (GRU).	3	CO2
	2.3	Transformers - architecture, self-attention mechanism, applications in natural language processing (NLP).	3	CO2
	2.4	Unsupervised learning - autoencoders, generative adversarial networks (GANs).	2	CO2
3.	Advanced Techniques in Deep Learning(11 hours)			

	3.1	Regularization - L1 and L2 regularization, dropout, data augmentation.	3	CO3
	3.2	Hyperparameter tuning - grid search, random search, Bayesian optimization.	2	CO3
	3.3	Transfer learning - pre-trained models, fine-tuning, domain adaptation.	2	CO3
	3.4	Multimodal learning - combining different modalities of data like text and images.	2	CO3
	3.5	Responsible AI - bias, fairness, explainability, privacy.	2	CO3
4.	Deep Learning Applications(12 hours)			
	4.1	Computer vision - image classification, object detection, image segmentation.	3	CO4
	4.2	Natural language processing - text classification, sentiment analysis, machine translation.	2	CO4
	4.3	Speech recognition and generation - automatic speech recognition (ASR), text-to-speech (TTS).	2	CO4
	4.4	Time series forecasting - predicting future values based on historical data.	2	CO4
	4.5	Anomaly detection - identifying unusual events in data.	3	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based

	collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty.* **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
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References:

1. Goodfellow, I., Bengio, Y., & Courville, A. (2023). Deep Learning (2nd ed.). MIT Press.
2. Goldberg, Y. (2021). A Primer on Neural Network Models for Natural Language Processing. John Wiley & Sons.
3. Aggarwal, C. C. (2023). Neural Networks and Deep Learning: A Textbook (3rd ed.). Springer.

Additional References:

1. Li, Z., Zhang, J., & Sun, Y. (2022). Neural Networks for Natural Language Processing. Springer Nature Switzerland AG.
2. Yang, X., Li, L., & Liu, J. (2022). Interpretable Deep Learning for Natural Language Processing. Springer Nature Switzerland AG.

4. SYLLABUS FOR DISCIPLINE SPECIFIC ELECTIVE COURSES

COURSE 01

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE301
Course Title	**Microprocessors and Assembly Language Programming using 8086**
Course Level	300-399
Course Summary	Microprocessor is a very useful tool for our modern communication. In fact the performance of any computer is vastly dependent on them. In this paper we have focused on the evolution of the microprocessors first, and then went for the categorization, organization, operation and some other fundamental things. Discussed about the several cycles that a microprocessor goes through and at last gave some ideas and aspects of assembly language programming
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the fundamental principles of microprocessor architecture and its operations,	Understand	PO1
2	Analyse the internal architecture of the 8086 microprocessor	Analyse	PO2

3	Demonstrate proficiency in programming techniques such as string manipulation, procedures, macros, and implementing standard programs	Apply	PO2
4	Analyze the role and programming of interrupts in 8086 microprocessors	Analyse	PO1, PO2
5	Evaluate the functionalities and operations of peripheral devices	Evaluate	PO2, PO8

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Introduction to Microprocessor (9 hours)			
	1.1	Microprocessor Architecture and its operations	1	CO1
	1.2	Microprocessor initiated operations	1	CO1
	1.3	8085 bus organization	1	CO1
	1.4	Internal data operations	1	CO1
	1.5	8085 registers	1	CO1
	1.6	Externally initiated operations	1	CO1
	1.7	Memory and instructions	1	CO1
	1.8	Peripheral mapped I/O	1	CO1
	1.9	8085 Microprocessor and its architecture	1	CO1
2	Internal Architecture of 8086(14 hours)			
	2.1	8086 Internal architecture	1	CO2

	2.2	Basic 8086 microcomputer system – system overview	1	CO2
	2.3	8086 bus	1	CO2
	2.4	Read machine cycle,Write machine cycle	1	CO2
	2.5	Assembly language programming – program development steps	1	CO2
	2.6	8086 instructions – data transfer instructions	1	CO2
	2.7	Arithmetic instructions	1	CO2
	2.8	Bit manipulation instructions	1	CO2
	2.9	String instructions	1	CO2
	2.10	Constructing the machine codes for 8086 instructions	1	CO2
	2.11	Standard program in 8086, If-then, If-then	1	CO2
	2.12	Unconditional jump instructions, condition flags, conditional jump instructions	1	CO2
	2.13	multiple if-then-else, while-do , repeat-until , loop instructions	1	CO2
	2.14	Instruction timing and delay loops	1	CO2
3	Procedures and Macros(7 hours)			
	3.1	Strings	1	CO3
	3.2	Procedures and Macros – 8086 string instructions	1	CO3
	3.3	Writing and using procedures	1	CO3

	3.4	CALL and RET instructions	1	CO3
	3.5	Stack-using PUSH and POP to save register contents	1	CO3
	3.6	passing parameters, reentrant and recursive procedures	1	CO3
	3.7	Writing and using macros	1	CO3
4	Concepts of Interrupts(15 hours)			
	4.1	8086 interrupts – program examples	2	CO4
	4.2	Interrupt Types	2	CO4
	4.3	8254 software – programmable TIMER	2	CO5
	4.4	COUNTER – basic 8253 and 8254 operations	2	CO5
	4.5	8255A, 8259A Priority interrupt controller	2	CO5
	4.6	Direct Memory Access data transfer – circuit connections	2	CO5
	4.7	Circuit connections and operations of the Intel 8257 DMA controller	2	CO5
	4.8	DMA transfer timing diagram	1	CO5
5	Teacher specific course components			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

<table>
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A. Continuous Comprehensive Assessment (CCA)
Theory:
Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. Any other method as may be required for a specific course by the course faculty.
Practical:
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Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.
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Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.</td></tr>
</table>

References:

1. Nagoor Kani - Microprocessor 8086 programming & interfacing,Second edition, Tata McGraw Hill Education.
2. Microprocessors and Interfacing , Programming and Hardware, Douglas V- Hall. Tata McGrawHill,1990.
3. Barry B.Brey - Architecture, Programming and Interfacing ,Eighth Edition, Prentice – Hall India.
4. The Intel Microprocessors 8086 / 8088 , 80186 / 80188 , 80286 , 80386 , 80486 , Pentium, and Pentium Pro processor.

COURSE 02

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE302
Course Title	**System Software**
Course Level	300-399
Course Summary	This course is focused on understanding the relationship between system software and machine architecture, design and implementation of assemblers, macro processor, linker and compiler.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	PO
1	Illustrate the concepts of different System Software.	Understand	PO1,PO2
2	Analyse SIC machine architecture with its instruction sets and capable to do programing. Illustrate machine dependent, independent assemblers and macro processors.	Analyse	PO1,PO2
3	Remember the functions of loaders, linkers and illustrate machine dependent loaders and independent loaders.	Apply	PO1,PO2, PO8
4	Explain the functions of compilers and illustrate machine dependent and independent compilers.	Understand	PO1,PO2, ,PO8

COURSE CONTENTS

Module	Units	Description	Hrs	CO
1	Introduction (13 hours)			
	1.1	System Software and Machine architecture.	3	CO1
	1.2	The simplified Instructional Computer (SIC& SIC/XE)	4	CO1
	1.3	Data and instruction formats – addressing modes	3	CO1
	1.4	Instruction sets - I/O and programming	3	CO1
2	Assemblers and Macro Processors (20 hrs)			
	2.1	Basic assembler functions - A simple SIC assembler – Assembler algorithm and data structures.	4	CO2
	2.2	Machine dependent assembler features – Instruction formats and addressing modes	4	CO2
	2.3	Program relocation - Machine independent assembler features - Literals, Symbol- defining statements	4	CO2
	2.4	Expressions -assembler design options: One pass assemblers and Multi pass assemblers.	4	CO2
	2.5	Basic macro processor functions - Macro definition and Expansion –- Implementation example –MASM Macro processor	4	CO2
3	Loaders and Linkers (12 hrs)			

	3.1	Basic loader functions - Design of an Absolute Loader, Machine dependent loader features	3	CO3
	3.2	Relocation – Program Linking	3	CO3
	3.3	Machine-independent loader features: Automatic Library Search, Loader Options.	3	CO3
	3.4	Linkage Editors, Dynamic Linking, Bootstrap Loaders	3	CO3
4	Compilers and system software tools (15 hrs)			
	4.1	Basic Compiler Functions and Structure of compiler.	3	CO4
	4.2	Text editors-Overview of the Editing Process-User Interface-Editor Structure	4	CO4
	4.3	Interactive debugging systems-Debugging functions and capabilities	4	CO4
	4.4	Relationship with other parts of the system-User-Interface Criteria.	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Peer Teaching, Discussion-based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific courses by the course faculty.* **Practical:** Observation of practical skills, Laboratory record, Any other method as may be required for specific courses by the course faculty.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.

References:

1. D. M. Dhamdhere, "Systems Programming and Operating Systems", Second Revised Edition, Tata McGraw-Hill, 1999.
2. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2000Santanu Chattopadhyay, "System Software", Prentice-Hall India, 2007
3. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools",2nd Edition, Pearson Education Asia

COURSE 03

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE303
Course Title	**Introduction to Cloud Technology**
Course Level	300-399
Course Summary	This course aims to provide students with a comprehensive insight into the world of cloud computing. Topics covered are cloud architecture, cloud deployment and service models and cloud security.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO'S
1	Analyse the trade-offs between deploying application in the cloud over traditional IT Infrastructure	Understand	PO1
2	Compare the advantages and disadvantages of various cloud computing platforms	Analyse	PO6
3	Analyse industry platforms, new developments and Deploy application on AWS	Apply	PO1, PO2
4	Identify security and privacy issues in cloud computing	Evaluate	PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
Introduction to Cloud Technology(10 Hours)				
1	1.1	Introduction to cloud Technology: History, The NIST Definition of Cloud, five essential Characteristics of Cloud: On-demand self-service, Broad Network Access, Resource pooling, Rapid Elasticity, Measured Service, Need for cloud technology	6	CO1
	1.2	Pros and cons of cloud, Challenges in cloud, Vulnerabilities of cloud Technology	2	CO1
	1.3	Comparing Cloud providers with traditional IT service providers and attributes of cloud computing	2	CO1
Cloud Insights(10 hours)				
2	2.1	Cloud Insights: Architectural influences: High Performance Computing, Utility and Enterprise grid computing.	3	CO2
	2.2	Principles of Parallel and Distributed Computing: Parallel vs Distributed computing, Elements of Distributed computing, Technologies for Distributed computing	3	CO2
	2.3	Basic Cloud Model, The NIST Cloud Model	2	CO2
	2.4	Service Models of cloud: SaaS, PaaS and IaaS, Deployment Models or types of cloud: Private, public cloud, Community cloud and Hybrid cloud	2	CO2
Fundamentals of Cloud Security(10 Hours)				
3	3.1	Basic Terms of cloud security	3	CO3
	3.2	Threat agents, Cloud Security Threats, Additional considerations, Risk Management	3	CO3
	3.3	Industrial Platforms and New Developments: Amazon Web Service, Google App Engine, Microsoft Azure	4	CO3
Migrating into Cloud and Case Studies(15 Hours)				
4	4.1	Migrating into Cloud: Introduction, Challenges while migrating into Cloud, Broad Approaches for migrating into a cloud,	4	CO3
	4.2	The Seven Step Model for Migrating into a cloud, Migration Risks and Mitigation.	3	CO4

	4.3	Enterprise Cloud computing Paradigm, Relevant Deployment Model for Enterprise Cloud Computing	3	CO1
	4.4	Adoption and Consumption strategies, issues for enterprise applications on the cloud	3	CO2
	4.5	Case Study on Cloud Providers	2	CO3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Cloud Computing a practical approach- Anthony T. Velte, Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill, New Delhi
2. Cloud Computing: Web Based Applications that change the way you work and Collaborate Online- Michael Miller-Que 2008
3. Cloud Computing for Dummies- Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Wiley Publishing, Inc, 2010.

COURSE 04

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE304
Course Title	**R Programming**
Course Level	300-399
Course Summary	This course covers the basics of R programming, including installation, data types, operators, control flow, functions, data manipulation, and data visualization.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4
Pre-requisite, if any	Basic Statistics

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand foundational concepts of R, including variables, functions, and operators.	Understand	PO1,PO2,PO8
2	Apply decision-making structures, loops, and functions to control program flow effectively.	Apply	PO1,PO2,PO8
3	Analyse the principles of manipulating text data and working with matrices, arrays, factors, and lists in R programming	Understand	PO1,PO2,PO8
4	Evaluate and synthesize knowledge to create, operate, and visualize data frames, facilitating comprehensive data analysis in R.	Analyze	PO1,PO2,PO8

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Introduction to R Programming (12 hours)			
	1.1	Fundamentals Of R- Installation of R & R Studio	2	CO1
	1.2	Features of R	1	CO1
	1.3	Variables in R, Constants in R	1	CO1
	1.4	Accepting Input from keyboard, Important Built-in functions	1	CO1
	1.5	R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame.	2	CO1
	1.6	R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables	2	CO1
	1.7	R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators.	3	CO1
2	Control Flow and Functions in R (13 hours)			
	2.1	R Decision Making: if statement, if – else statement, if – else if statement, switch statement	3	CO2
	2.2	R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement	3	CO2
	2.3	Functions In R - Formal and Actual arguments, Named arguments, Global and local variables, Argument and lazy evaluation of functions, Recursive functions.	4	CO2
	2.4	R Matrices - Creating matrices, Accessing elements of a Matrix, Operations on Matrices, Matrix transpose	3	CO3
3	Data Structures in R (10 hours)			
	3.1	R-Strings – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower().	3	CO3

	3.2	R Lists - Creating lists, Manipulating list elements, Merging lists, Converting lists to vectors	3	CO3
	3.3	Arrays In R - Creating arrays, Accessing array elements, Calculations across array elements	2	CO3
	3.4	Factors - Understanding factors, Modifying factors, Factors in Data frames.	2	CO3
4	Exploring and Visualizing Data in R (10 hours)			
	4.1	Data Frames In R - Creating data frame, Operations on data frames, Accessing data frames, Creating data frames from various sources	2	CO4
	4.2	Data Visualization In R - Need for data visualization	2	CO4
	4.3	Bar plot, Plotting categorical data, Stacked bar plot, Histogram	1	CO4
	4.4	plot() function and line plot, pie chart / 3D pie chart, Scatter plot, Box plot	2	CO4
	4.5	Stringr Package - Important functions in stringr, Regular expressions.	3	CO4
5	Teacher specific course components			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:**

	Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Michael J. Crawley- The R Book -2023-3rd edition
2. Sudha G Purohith,Sharad D Gore,Shailaja R Deshmukh -Statistics using R-2015-2nd
3. edition.
4. Hadley Wickham-Advanced R-2019-2nd edition
5. Hadley Wickham & Garrett Grolemund-R for DataScience-2023-2nd edition

COURSE 05

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE305
Course Title	**Basic Android**
Course Level	300-399
Course Summary	This course provides an introduction to Android application development using the Java programming language. Students will learn the fundamentals of Android development, including user interface design, activity lifecycle, data storage, and networking.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4
Pre-requisite, if any	Students should have knowledge in Java programming

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the principles of UI design and layouts in Android.	Understand	PO1, PO2
2	Explain the lifecycle methods of an Android Activity and Fragments	Understand	PO1, PO2
3	Apply various data storage techniques to store application data locally	Apply	PO1, PO2
4	Create Android apps with various features	Create	PO1, PO2

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	Overview of Android Platform (13 hours)			
	1.1	Introduction to Android platform History and evolution of Android Setting up the development environment (Android Studio)	5	CO1
	1.2	Understanding Android project structure Components of an Android application (Activities, Services, Broadcast Receivers, Content Providers) Android Manifest file and its importance	4	CO1
	1.3	Views and Layouts XML Layouts Event Handling	4	CO1
2	Understanding Activity lifecycle (12 hours)			
	2.1	Activity Lifecycle, Managing state changes Handling configuration changes	4	CO2
	2.2	Intent and Intent Filters Implicit and Explicit Intents Broadcast Receivers	4	CO2
	2.3	Fragments, Fragment Life cycle Communicating between Fragments File I/O	4	CO2
3	Data Storage in Android(10 hours)			
	3.1	Internal and External Shared Preferences	2	CO3
	3.2	SQlite Database CRUD Operations	4	CO3

	3.3	Content Providers Basics of Content Providers and their role in Android architecture. Implementing a custom Content Provider to share data within an app. Accessing data from built-in Content Providers like Contacts, Calendar, etc.	4	CO3
4	Dealing with Multimedia(10 hours)			
	4.1	Working with Multimedia: Introduction, Using ImageView to display images in an Android application. Loading images from various sources like resources, assets, and URLs. Techniques for optimizing image loading and caching to improve performance.	4	CO4
	4.2	Using MediaPlayer for audio and video playback. Handling audio focus and managing playback controls. Implementing features like play, pause, stop, seek, and volume control.	4	CO4
	4.3	Accessing the device camera using Camera API or Camera2 API. Capturing photos and videos programmatically.	2	CO4
	4.4	Deploying an app in playstore: steps	2	C04

Practicals (30 Hrs)

- Create an app that takes user input through EditText and displays it using TextView.
- Introduce the concept of references to UI elements using findViewById().
- Develop apps to store and retrieve data using SharedPreferences, SQLite database, and file I/O.
- Implement programs to read from and write to files, demonstrating file handling concepts.
- Explore concepts like Fragments, AsyncTask, and RecyclerView to build more complex Android applications.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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	B. End Semester Examination (ESE) Theory: *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* Practical: *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Brian Hardy
2. "Android App Development for Dummies" by Michael Burton
3. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Chris Stewart
4. "Head First Android Development: A Brain-Friendly Guide" by Dawn Griffiths and David Griffiths

COURSE 06

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE306
Course Title	**Network Security**
Course Level	300-399
Course Summary	This course allows the students to explore various security mechanisms used in the system as well as in networking.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain various security measures and techniques used to protect data communication.	Remember	PO1, PO2
2	Apply various complex data encryption standards.	Apply	PO4, PO6
3	Explain the public key and private key encryption standards.	Understand	PO2, PO5
4	Apply the security measures	Apply	PO7, PO8

COURSE CONTENT

Module	Units	Course description	Hrs	CO.
1	Classical Encryption Techniques (16 hours)			
	1.1	Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack,	3	CO1
	1.2	Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher,	3	CO1
	1.3	Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad.	2	CO1
	1.4	Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher,	2	CO1
	1.5	The data encryption standard, DES encryption, DES decryption	2	CO2
	1.6	A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm	2	CO2
	1.7	Timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm	2	CO2
2	Public-Key Cryptography and RSA (12 hours)			
	2.1	Principles of public-key cryptosystems. Public-key cryptosystems	2	CO1
	2.2	Applications for public-key cryptosystems, requirements for public-key cryptosystems	2	CO1
	2.3	public-key cryptanalysis.	2	CO3
	2.4	The RSA algorithm, description of the algorithm, computational aspects, the security of RSA.	2	CO3
	2.5	Diffie-hellman key exchange,	2	CO3
	2.6	The algorithm, key exchange protocols, man in the middle attack,Elgamal Cryptographic systems	2	CO4
3	Cryptography (16 hours)			
	3.1	Elliptic curve arithmetic, abelian groups	2	CO3

	3.2	Elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography	2	CO3
	3.3	Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption	2	CO3
	3.4	Security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA.	2	CO3
	3.5	Symmetric key distribution using Symmetric encryption, A key distribution scenario	2	CO4
	3.6	Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage	2	CO4
	3.7	Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication	2	CO4
	3.8	A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory,public key authority, public keys certificates.	2	CO4
4	User Authentication (6 hours)			
	4.1	Remote user Authentication principles, Mutual Authentication, one wayAuthentication, remote user Authentication using Symmetric encryption	2	CO4
	4.2	Authentication, one way Authentication, Kerberos, Motivation	2	CO4
	4.3	Kerberos version 4, Kerberos version 5,	2	CO4
5	Electronic Mail Security (10 hours)			
	5.1	Remote user Authentication using Asymmetric encryption	2	CO3
	5.2	Mutual Authentication, one way Authentication	2	CO3
	5.3	Pretty good privacy, notation, operational, description, S/MIME, RFC5322	2	CO3
	5.4	Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing,	2	CO1

	5.5	Enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow.	2	CO1

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty.* **Practical:** *Observation of practical skills, Laboratory record, Any other method as may be required for specific course by the course faculty*.
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References:

1. Computer Networks, Fifth Edition by David J. Wetherall, Andrew S. Tanenbaum
2. Schneier, B. (1996) Applied Cryptography, 2nd edn, Wiley.
3. Stallings, W (1999) Cryptography and Network Security, Prentice Hall.
4. Stallings, W (2001) SNMP, SNMPv2, SNMPv3, and RMON 1 and 2, 3rd edn, Addison Wesley.
5. Halsall, F. (2001) Multimedia Communications, Addison Wesley.
6. ITU-T X.509 (2000) Information Technology – Open Systems Interconnection – The Directory: Public-Key and Attribute Certificate Frameworks , International Telecommunication Union.
7. King, T. and Newson, D. (1999) Data Network Engineering, Kluwer.
8. Peterson, L. L. and Davie, B. S. (1996) Computer Networks: A Systems Approach, Morgan Kaufmann.
9. RFC 2401 (1998) Security Architecture for the Internet Protocol, Kent, S., Atkinson,R.

Further Reading:

1. Anderson, R. (2001) Security Engineering: A Guide to Building Dependable Distributed Systems , Wiley.
2. BS 7799-2 (2002) Information Security Management Systems – Specification with Guidance for Use , British Standards Institution.
3. Ellis, J. and Speed, T. (2001) The Internet Security Guidebook, Academic Press.
4. ISO/IEC 17799 (2000) Information Technology – Code of Practice for Information Security Management , International Organization for Standardization.
5. Tanenbaum, A. S. (1996) Computer Networks, 3rd edn, Prentice Hall.

COURSE 07

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE307
Course Title	**Theory of Automata**
Course Level	300-399
Course Summary	Automata theory is basically about the study of different mechanisms for generation and recognition of languages. Automata theory is basically for the study of different types of grammars and automata. A grammar is a mechanism for the generation of sentences in a language.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Evaluate concepts in automata theory	Understand	PO1
2	Formulate grammars and recognizers for different formal languages	Apply	PO2
3	Prepare Finite Automata, NFA, Push Down Automata	Apply	PO2, PO3
4	Explain Turing Machines and types of Turing Machines	Understand	PO2
5	Analyze the lexical, syntactic and semantic structures of language features	Analyse	PO2, PO3

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Automata Theory(20 hours)			
	1.1	Automata Theory: Concepts of Automata Theory	2	CO1
	1.2	Formal Language and Regular Expressions	2	CO1
	1.3	Chomsky Hierarchy of Grammar	2	CO1
	1.4	Regular Grammar	2	CO1
	1.5	Finite Automata – DFA, NFA	2	CO2
	1.6	Conversion of regular expression to NFA, NFA to DFA	2	CO2
	1.7	Finite Automata with Epsilon Transitions	2	CO2
	1.8	Eliminating Epsilon Transition	2	CO2
	1.9	FAs & Regular Expressions	2	CO2
	1.10	Minimization of DFA, FA with outputs	2	CO2
2	Context Free grammars (16 hours)			
	2.1	CFG	2	CO2
	2.2	Parse Trees	2	CO2
	2.3	Ambiguity in Grammar	2	CO2
	2.4	Removal of Left Recursion	2	CO2
	2.5	Left Factoring	2	CO2
	2.6	Push Down Automata-Languages	2	CO3

	2.7	Equivalence of PDA's and CFG's	2	CO3
	2.8	Deterministic Pushdown Automata	2	CO3
3	Turing Machines(10 hours)			
	3.1	Transition Diagrams for Turing Machines	2	CO4
	3.2	Language of a Turing Machine Turing Machines and Halting	2	CO4
	3.3	Multitape Turing Machines	2	CO4
	3.4	Equivalence of OneTape and Multitape TM's	2	CO4
	3.5	Undecidable Problems about Turing Machines	2	CO4
4	Compiler (14 hours)			
	4.1	Phases of Compiler	2	CO5
	4.2	role of Lexical Analyzer,	2	CO5
	4.3	specification & recognition of Tokens using Regular Expressions	2	CO5
	4.4	Syntax Analysis: Parsing	2	CO5
	4.5	Top-Down Parsing: Recursive Descent parsing, Predictive parsing	2	CO5
	4.6	Bottom-Up Parsing: Shift Reduce parsing LR , SLR , CLR & LALR parsers	2	CO5
	4.7	Compiler Construction Tools	2	CO5
5	Teacher specific course components			

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1. Aho, Ullman, Ravi Sethi , ‘Compilers Principles, Techniques and Tools’ , Pearson Education.
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman ,’ Introduction to automata theory, languages and computation’
3. Sipser ‘ Introduction to Theory of computation ‘ ,2nd Edition, Thomson.
4. Andrew W.Appel, ‘Modern Compiler Construction in C ‘, Cambridge University Press.
5. LOUDEN, ‘ Compiler Construction , Principles & Practice‘ , Thomson.

COURSE 08

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE308
Course Title	**Computer Graphics**
Course Level	300-399
Course Summary	Through this course students get awareness about the mathematical foundations of computer graphics and various algorithms.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain components of a graphics system and become familiar with the building approach of graphics system components and algorithms related to them.	Understand	PO1, PO2
2	Learn the basic principles of 3- dimensional computer graphics.	Understand	PO3,PO6
3	Analyse how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.	Analyse	PO5, PO2
4	Describe the mapping from a world coordinate to device coordinates, clipping, and projections.	Analyse	PO4, PO6
5	To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.	Evaluate	PO7, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO.
1	Image Representation & Scan Conversion(16 Hours)			
	1.1	Image Representation: The RGB Colour model, Direct coding, Lookup table, Display monitor, Printer, Image files, Setting the colour attributes of pixels,	4	CO2
	1.2	Scan Conversion: Scan-converting a point, Scan converting a line, Scan-converting a circle	4	CO3
	1.3	Scan-converting a Ellipse, Scan-converting a arcs and sectors	4	CO3
	1.3	Scan-converting a Rectangle, Region filling, Scan-converting a character, Anti-Aliasing	4	CO1
2	Two Dimensional Transformations(10 Hours)			
	2.1	Two-Dimensional Transformation: Geometric transformations	4	CO2
	2.2	Coordinate transformations, Composite transformations, Instance transformations	4	CO2
	2.3	Two-Dimensional Viewing and Clipping: Window–to-Viewport mapping, Point clipping, Line Clipping, Polygon Clipping	2	CO2
3	Three Dimensional Transformations(10 Hours)			
	3.1	Three-Dimensional Transformations: Geometric transformations, Coordinate transformations	4	CO2
	3.2	Composite transformations, Instance transformations.	4	CO2
	3.3	Three-Dimensional Viewing and Clipping: Three-Dimensional Viewing, Clipping, Viewing Transformation.	2	CO4
4	Geometric representation(9 hours)			
	4.1	Geometric Representation: Simple Geometric forms, wireframe models, curved surfaces, curved design, polynomial basis functions	3	CO4
	4.2	The problem of interpolation, the problem of approximation, curves surface design, transforming curves and surfaces	3	CO5

	4.3	Hidden Surfaces: Depth Comparisons, z-Buffer algorithm, back face removal, the painters algorithms, scan-line algorithm subdivision algorithm.	3	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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References:

1. Zhigang Xiang and Roy Plastock-2006-Computer Graphics Schaum's outlines 2nd Edition - McGraw Hill Education.
2. Donald Hearn and M.Pauline Baker-2000-Computer Graphics C version 2 Edition – PEARSON Education.
3. William M. Newman and Robert F. Sproull-2001-Principles of Interactive Computer Graphics 2nd Edition- McGraw Hill.
4. Yashwant Kanetkar-2003-Graphics under C-BPB publications

COURSE 09

Discipline/Programme	Computer Science
Semester	V/VI
Type of Course	DSE
Course Code	24UCAPDSE309
Course Title	**Image Processing**
Course Level	300-399
Course Summary	This course delves into the exciting field of image processing, equipping you with the skills to manipulate, analyze, and interpret digital images using powerful computer algorithms.
Lecture/Tutorial/Practical Hours	60/0/0
Credits	4
Pre-requisite, if any	Students with solid foundation in Graphics is preferable

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the concept of digital image representation and how images are stored on computers.	Understand	PO1
2	Implement various image processing filters (smoothing, sharpening, edge detection) on sample images.	Apply	PO1
3	Evaluate the techniques for image enhancement and image restoration	Analyse	PO2
4	Interpret the results of image segmentation algorithms, compression standards and assess their accuracy.	Evaluate	PO1, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Digital image processing (14 hours)			
	1.1	Introduction: Digital image Processing, Origins of Digital Image Processing, Applications and Examples of Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System	3	CO1
	1.2	Digital image Fundamentals: Elements of Visual Perception, Light and electromagnetic spectrum, imaging sensing and acquisition, image sampling and quantization. Some basic relationship between pixels, Introduction to the mathematical tools used in digital image processing.	5	CO1
	1.3	Image Transform: Need for image transforms, Spatial Frequencies in image processing, Introduction to Fourier transform, Discrete Fourier transform, Fast Fourier transform and its algorithm, Properties of Fourier transform. Discrete sine transforms. Walsh Transform, Hadamard transform, Haar transform, Slant transform, SVD and KL transforms or Hotelling transform.	6	CO1
2	Intensity Transformations and Spatial Filtering(11 hours)			
	2.1	Background, Some basic intensity transformation functions, histogram processing, fundamentals of s spatial filtering, Smoothing spatial filters, sharpening spatial filters, Combining Spatial enhancement methods, using fuzzy techniques for intensity transformation and spatial filtering	6	CO2
	2.2	Filtering in the frequency domain: Preliminary concepts, Sampling and the Fourier transform of sampled functions, the discrete Fourier Transform on one variable, Extension to functions of two variables, Some properties of the 2-D Discrete Fourier Transform, The basic of filtering in the frequency domain, image smoothing using frequency domain filters, Selective filtering	5	CO2
	Feature Extraction Methods (8 hours)			

3	3.1	Feature extraction methods: Histograms of oriented gradients (HOG) Local Binary patterns (LPB), Gabor Filters, Gray Level Co-occurrence Matrix(GLCM)	4	CO3
	3.2	Edge detection(Canny Edge detector) thresholding segmentation, Region-based segmentation, Morphological image processing, Feature extraction techniques(corners, blobs, textures) PCA.	4	CO3
4	Wavelets, Multi resolution Processing and Image Processing(12 Hours)			
	4.1	Image pyramids, sub band coding & Haar transform multi resolution expressions, wavelet transforms in one dimension. The fast wavelets transform, wavelet transforms in two dimensions, color image compression.	4	CO3
	4.2	Image compression: fundamentals, various compression methods- coding techniques, digital image water marking.	4	CO4
	4.3	Applications of Image processing: Medical Image Processing (Segmentation of tissues in MRI Scans), Remote sensing (land cover classification from satellite imagery). Computer Vision application (face detection, object tracking)	4	CO4

Practical (30 hrs)

- Image Fundamentals: Dive into pixels, color models, and common image formats (JPEG, PNG).
- Processing Techniques: Explore filtering (smoothing, sharpening), enhancement (contrast, noise reduction), and restoration.
- Image Analysis: Master segmentation (separating objects) and feature extraction (identifying key characteristics).
- Hands-on Projects: Apply your skills! Implement image processing techniques on real-world datasets using tools like OpenCV.
- Beyond Basics: (Optional) Explore advanced topics like object detection or image classification (depending on course depth).

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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References:

1. Digital Image Processing- R. C Gonzalez and R.E Woods
2. "Fundamentals of Digital Image Processing"- Anil K. Jain, Prentice Hall of India, 9th Edition,2002
3. "Digital Image Processing"- Jayaraman, S. Esakkirajan and T. VeeraKumar, 2011
4. "Fundamentals of Digital Image Processing"- Anil K. Jain, Prentice Hall of India, 9th Edition,2002
5. "Digital Image Processing"- Jayaraman, S. Esakkirajan and T. VeeraKumar, 2011

COURSE 10

Discipline/Programme	Computer Science
Semester	VIII
Type of Course	DSE
Course Code	24UCAPDSE401
Course Title	**Natural Language Processing**
Course Level	400-499
Course Summary	This course empowers you to bridge the gap between human and machine language. It delves into the fundamentals of language structure and explore core NLP techniques like machine learning and deep learning.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4
Pre-requisite, if any	Understanding of ANN, Deep Learning models etc

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO's
1	Evaluate the core concepts and challenges of Natural Language Processing.	Analyse	PO4
2	Analyze and process textual data using NLP techniques.	Analyse	PO2, PO3, PO6
3	Implement machine learning and deep learning models for various NLP tasks.	Apply	PO1, PO2, PO6
4	Apply NLP techniques to solve real-world problems in different domains.	Apply	PO1, PO2, PO8

COURSE CONTENTS

Module	Units	Description	Hrs	CO
1.	Introduction to Natural Language Processing(11 hours)			
	1.1	Define Natural Language Processing and its core tasks	3	CO1
	1.2	Understand the history and evolution of NLP	3	CO1
	1.3	Explore various applications of NLP in different domains, such as machine translation, text summarization, sentiment analysis, and chatbots	2	CO1
	1.4	Identify the challenges and limitations of NLP techniques, such as ambiguity, linguistic diversity, and computational complexity	3	CO1
2.		Fundamentals of Language(10 hours)		
	2.1	Language structure and levels - phonology, morphology, syntax, semantics, and pragmatics	2	CO2
	2.2	Morphological analysis - segmentation, stemming, and lemmatization	2	CO2
	2.3	Syntactic analysis - parts-of-speech tagging and parsing (constituency parsing and dependency parsing)	2	CO2
	2.4	Semantic analysis - word sense disambiguation and semantic representation models (WordNet, ontologies)	2	CO2
	2.5	Pragmatics - understanding context, speaker intention, and non-literal language	2	CO2
3.	NLP Techniques and Tools(8 hours)			
	3.1	Text processing - tokenization, normalization, stemming, lemmatization, stop word removal	2	CO3

	3.2	Machine learning for NLP - classification algorithms (Naive Bayes, Support Vector Machines), feature extraction, and evaluation metrics	2	CO3
	3.3	Deep learning for NLP - recurrent neural networks (RNNs), Long Short-Term Memory (LSTM) networks, transformers, and their applications in NLP tasks	2	CO3
	3.4	Popular NLP libraries and frameworks - NLTK, spaCy, TensorFlow, PyTorch	2	CO3
4.	Applications of Advanced NLP(16 hours)			
	4.1	Machine translation - statistical machine translation (SMT) and neural machine translation (NMT)	2	CO4
	4.2	Text summarization - extractive and abstractive summarization techniques	2	CO4
	4.3	Chatbot development - conversational agents and dialogue systems	2	CO4
	4.4	Information extraction - named entity recognition, relation extraction, and event extraction	2	CO4
	4.5	Question answering systems - open-domain and closed-domain question answering	2	CO4
	4.6	Ethical considerations in NLP - bias, fairness, and transparency	3	CO4
	4.7	Emerging trends in NLP - explainable AI, natural language understanding, and multimodality	3	CO4

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Primary References:

1. Manning, C. D., Schütze, H., & Raghavan, P. (2008). Introduction to Information Retrieval. Cambridge University Press.
2. Jurafsky, D., & Martin, J. H. (2020). Speech and Language Processing (3rd ed.). Pearson Education.
3. Bird, S., Klein, E., & Loper, E. (2009). Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit. O'Reilly Media.

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1. Goldberg, Y. (2017). Neural Network Methods for Natural Language Processing. Morgan Kaufmann.
2. Collobert, R., Weston, J., Bottou, L., Karlen, M., Kavukcuoglu, K., & Kuksa, P. (2011). Natural language processing (almost) from scratch. Journal of Machine Learning Research, 12(Aug), 2493-2537.

COURSE 11

Discipline/Programme	Computer Applications
Semester	VIII
Type of Course	DSE
Course Code	24UCAPDSE402
Course Title	**Blockchain Technologies**
Course Level	400-499
Course Summary	Learn the blockchain technology and the distributed file system.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the basics of Block chain technology and its working principles.	Understand	PO1, PO3
2	Infer cryptographic foundations of Blockchain technology	Understand	PO1, PO2
3	Familiarize Block chain transactions and its challenges.	Analyse	PO5, PO8, PO7
4	Create smart contracts and a blockchain model.	Create	PO5, PO6

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	Introduction to BlockChain(11 hours)			
	1.1	Basic of Blockchain Architecture – Challenges – Applications – Block chain Design Principles -The Blockchain Ecosystem	3	CO2
	1.2	The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis	2	CO2
	1.3	Nakamoto Consensus on permission-less, nameless, peer-to-peer network	2	CO1
	1.4	Abstract Models for BLOCKCHAIN - GARAY model - RLA Model	2	CO3
	1.5	Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness	1	CO1
	1.6	Proof of Stake (PoS) based Chains – Hybrid models (PoW + PoS).	1	CO1
2.	Cryptographic Fundamentals(7 hours)			
	2.1	Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm	4	CO2
	2.2	RSA, SHA 256	2	CO2
	2.3	Signature schemes, encryption schemes and elliptic curve cryptography	1	CO2
3.	Introduction to BitCoin(9 hours)			
	3.1	Introduction to Hyperledger- Hyperledger framework - Public and Private Ledgers.	1	CO1
	3.2	Bit coin - Wallet - Blocks - Merkley Tree	2	CO1

	3.3	Hardness of mining - transaction verifiability - anonymity	2	CO2
	3.4	Forks - double spending - mathematical analysis of properties of Bit coin	2	CO2
	3.5	Blockchain, the challenges, hyper-convergence architecture, scalability problems and solution algorithms and solutions	1	CO3
	3.6	Bitcoin scripting language and their uses	1	CO2
4.	Ethereum(10 hours)			
	4.1	Ethereum - Ethereum Virtual Machine (EVM)	2	CO2
	4.2	Wallets for Ethereum - Solidity - Smart Contracts, some attacks on smart contracts	3	CO2
	4.3	Ethereum and Smart Contracts- The Turing Completeness of Smart Contract Languages and verification challenges	2	CO3
	4.4	Comparing Bitcoin scripting vs. Ethereum Smart Contracts	3	CO4
5.	Recent Trends in Blockchain(11 hours)			
	5.1	Blockchain Implementation Challenges- Zero Knowledge proofs and protocols in Block chain	3	CO4
	5.2	Succinct non interactive argument for Knowledge (SNARK)	3	CO3
	5.3	Pairing on Elliptic curves – Zcash	2	CO4
	5.4	Attacks on Blockchains - such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms	3	CO4

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References:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O‟Reilly, first edition – 2015.
2. Daniel Drescher, “Bloc Chain Basics”, Apress; 1st Edition, 2017
3. Anshul Kaushik, “BlockChain and Crypto Currencies”, Khanna Publishing House, Delhi.
4. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, first edition – 2012.
5. Ritesh Modi, “Solidity Programming Essentials: A Beginner‟s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing.

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1. https://developer.ibm.com/patterns/create-and-deploy-block chain-network-using fabric-sdk-java/
2. https://docs.docker.com/getstarted/https:/console.ng.bluemix.net/docs/services/blo ck%2520chain/index. html

COURSE 12

Discipline/Programme	Computer Science
Semester	VIII
Type of Course	DSE
Course Code	24UCAPDSE403
Course Title	**Generative AI**
Course Level	400-499
Course Summary	This course introduces students to the dynamic field of Generative Artificial Intelligence (Generative AI), covering foundational concepts, model architectures, and practical applications. The curriculum is structured into four modules, each addressing key aspects of Generative AI.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe generative models' ethical usage, including bias and fairness.	U	PO1,PO2,PO4,PO 6,PO7,PO8
2	Apply GANs and VAEs: Implementing architectures, training models, and exploring applications.	A	PO1,PO2,PO4,PO 6,PO7,PO8
3	Explore recent advances in generative AI:	An	PO1,PO2,PO4,PO 6,PO7,PO8
5	Apply generative models (GANs, VAEs) using Python/Tensor Flow	A	PO1,PO2,PO4,PO 6,PO7,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Generative Models (12 hours)			
	1.1	Overview of Generative Models, Introduction to generative models and their role in artificial intelligence. Understanding the difference between generative and discriminative models	4	CO1
	1.2	Types of Generative Models, Probabilistic models: Gaussian Mixture Models (GMM), Hidden Markov Models (HMM).Variational Autoencoders (VAEs) and their applications.	4	CO1
	1.3	Introduction to Generative Adversarial Networks (GANs). Applications, Ethical Considerations and Privacy concerns related to generative models. Understanding bias and fairness in generative AI. Responsible use of generative models in various domains.	4	CO1
2	Introduction to GANs Core concepts of GANs: (28 hours)			
	2.1	generator, discriminator, adversarial training. Historical development and key milestones in GAN research.	4	CO2
	2.2	Architectures and Variants of GANs, DCGAN, WGAN, and other variants. Conditional GANs and their applications.	4	CO2
	2.3	Training and Stability Issues: Techniques for stable GAN training. Dealing with mode collapse and other common issues.	4	CO2
	2.4	Applications of GANs: Image-to-image translation using GANs. Super-resolution and style transfer.	4	CO2
	2.5	Introduction to VAEs: Understanding the encoder-decoder architecture. The role of variational inference in VAEs.	4	CO2
	2.6	Training VAEs: The reparameterization trick and backpropagation. Comparing VAEs to traditional autoencoders.	4	CO2
	2.7	Applications of VAEs: Image generation and reconstruction. Latentspace exploration and manipulation. VAEs in semi-supervised learning.	4	CO2
3	(16 hours)			
	3.1	Advanced Topics and Future Directions: Recent Advances in Generative AI Attention mechanisms in generative models. Self-supervised learning and its application in generative tasks.	4	CO3

	3.2	Generative AI in Industry, Use cases and applications in various industries. Challenges and opportunities in deploying generative models.	4	CO3
	3.3	Research Trends and Future Directions, Cutting-edge research in generative AI.Potential breakthroughs and challenges on the horizon.	4	CO3
	3.4	Final Project and Capstone, Students work on a generative AI project of their choice. Presentation and discussion of project outcomes.	4	CO3
4	(19 hours)			
	4.1	Introduction to Python and TensorFlow: Setting up TensorFlow environment, Basic operations in TensorFlow.	3	CO4
	4.2	Fundamentals of Generative Models: Implementing basic probabilistic models (Gaussian Mixture Models, Hidden Markov Models) using Python. Hands-on exercise on Variational Auto encoders (VAEs).	3	CO4
	4.3	Introduction to Generative Adversarial Networks (GANs): Building a simple GAN model for generating synthetic data. Understanding the generator and discriminator networks. Training a GAN on a small dataset.	3	CO4
	4.4	4: Advanced GANs and Applications: Implementing conditional GANs for specific tasks. Exploring image-to- image translation using Pix2Pix or CycleGAN. Applying GANs in medical imaging or other domains.	3	CO4
	4.5	Variational Auto encoders (VAEs) in Depth: Building a VAE for image generation. Understanding the concept of latent space. Exploring applications in semi-supervised learning.	4	CO4
	4.6	Attention Mechanisms and Self-Supervised Learning: Implementing attention mechanisms in generative models. Hands-on with self-supervised learning techniques	3	CO4

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References:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville(2016) . Deep Learning" . MIT Press
2. David Foster(2019)."Generative Deep Learning". O'Reilly Media
3. "Hands-On Generative Adversarial Networks with Keras" by Rajalingappaa Shanmugamani

5. SYLLABUS FOR MINOR COURSES

COURSE 01

Discipline/Programme	Computer Science
Semester	I/II
Type of Course	DSC
Course Code	24UCAPDSC103
Course Title	**Desktop Engineering**
Course Level	100-199
Course Summary	The goal of this course is to present an overview of IT tools used in day to day use of computers and database operations. The Course has been designed to provide knowledge on various hardware and software components of computer, operating system, various packages used for different applications of business management.
Lecture/Tutorial/Practical Hours	**45/0/30**
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the hardware and software components of computer.	Understand	PO1, PO8
2	Use the packages of MS Office.	Apply	PO1, PO2, PO8
3	Understand various database concepts and operations.	Understand	PO1,PO2, PO6,PO8
4	Analyse various issues related to IT applications.	Analyse	PO1, PO2 ,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Applications of Computers, Windows and Word Processing (10 Hours)			
	1.1	Introduction to Computers – ABACUS, Functional Units of Computer, Types of Memory.	2	CO1
		Generations of Computers	3	
	1.2	Applications of computers, Softwares and Hardwares.	2	CO1
	1.3	Windows Basic- Word processing, Worksheet and shell- Getting started with Excel, Edit cell and using commands and functions- Moving & Copying, Mail merge,Inserting & Deleting rows & Columns- Printing worksheet.	3	CO2
2	Understanding Excel Charts &Database (13 Hours)			
	2.1	Creating charts- Naming ranges and using statistical, math and financial functions, Database in a worksheet, Additional formatting command and drawing toolbar, Other commands and functions	4	CO2
	2.2	Introduction to Database development: Database Terminology, Objects, Creating tables,	4	CO3
	2.3	Understanding Data types, Changing Table design, Assigning Field properties, Setting primary queries: Creating simple query by design and by wizard.	5	CO3
3	Introduction to Powerpoint Presentation (10 Hours)			
	3.1	Overview of Powerpoint- Slide Layouts and Templates, Designing and formatting slides: Themes, Text,images-formatting.	3	CO3
	3.2	Advanced Tools and Features: Slide Transitions and Animation Effects, Slidemaster, Macro.	3	CO4
	3.3	Over view of PowerPoint presentation shows for corporate and commercial application.	4	CO4
4	Internet and Web features (12 Hours)			
	4.1	Introduction to Internet- History of Internet, Intranet & Extranet, Services on Internet – WWW,Search engine, Email, Social media.	4	CO3
	4.2	Introduction to Desktop publishing- Computer Viruses	4	CO4
	4.3	Web features: Web 1.0, Web 2.0 and Web 3.0,Networking Protocols, URL, Web Browsing.	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References :

1. "Swinford, E., Dodge, M., Couch, A., Melton, B. A. (2013). Microsoft OfficeProfessional 2013. United States: O'Reilly Media.
2. Wang, W. (2018). Office 2019 For Dummies. United States: Wiley. Microsoft Lambert, J. (2019). Microsoft Word 2019 Step by Step. United States: Pearson Education
3. Jelen, B. (2013). Excel 2013 Charts and Graphs. United Kingdom: Que.
4. Alexander, M., Jelen, B. (2013). Excel 2013 Pivot Table Data Crunching. UnitedKingdom: Pearson Education.
5. Alexander, M., Kusleika, R. (2018). Access 2019 Bible. United Kingdom: Wiley

Web References:

6. https://www.tcworkshop.com/data/Downloads/TCW_Courseware/Excel/DataAnalysis.pdf
7. https://www.w3schools.com/excel/index.php

COURSE 02

Discipline/Programme	Computer Science
Semester	I/II
Type of Course	DSC
Course Code	24UCAPDSC104
Course Title	**Introduction to Analytics with Excel**
Course Level	100-199
Course Summary	This course will provide an introduction to MS Excel and how it is used in data analytic and decision making. The course also provides insight on creating a formula to apply in practical scenario and arriving at meaningful conclusions , enabling effective decision making.
Lecture/Tutorial/Practical Hours	20/10/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	To understand the concept of data driven decision making	Understand	PO1
2	To understand the roles and responsibilities of a business Analyst	Understand	PO2
3	To apply Excel formulae in analysis and decision making	Apply	PO3
4	Analyse and visualize data: Students will learn how to use Excel's advanced data analysis tools and features to analyse and visualize data effectively	Analyse	PO2
5	Develop proficiency in Excel: Students will become proficient in using various Excel functionalities, including data entry, formula creation, graphing, pivot tables, and data manipulation.	Create	PO5,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Monetizing data to drive business decisions and organizing data with Excel			
	1.1	Need for data driven decision making - Solving the business problem using Analytics - Overview of Analytical cycle and Hierarchy of information user	5	CO1
	1.2	The Complete BA professional - Understand BA roles and Responsibilities - Identify the Popular BA Tools	5	CO2
	1.3	Formatting cells -Numbers – input data – percentages – text clear format – move or copy worksheet – freeze- title - formula bar	5	CO1
	1.4	Practical	3	CO3
2	Searching and Combining Data with Power Query			
	2.1	Getting started with Power Query - Know the Environment tabs and toolbars - Access new or existing reports	5	CO3
	2.2	Importing and combining data from databases, web, files - Splitting and aggregating data	5	CO3
	2.4	Practical	4	CO4
3	Formulas in Excel			
	3.1	Understanding formulas - Calculate with an Operator - Calculate Using a Function and Cell Addresses - Create an Array Formula using the Sum, Average, Count, Min, and Max Functions	5	CO4
	3.2	Manage Formula – edit formula – check formula	5	CO4
	3.3	Functions in Excel- conditional formula – V Look up	5	CO4

	3.5	Practical	8	CO5
4	Pivot table			
	4.1	Pivot table and charts - Loading Data into Power Pivot - Using Power Query and Power map add- ins - Designing Pivot Table reports - Filtering data	5	CO5
	4.3	Practical	15	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practicum:** Experiential learning, Presentations, Observation of practical skills, Field Visits, Surveys, Interviews, Case study, Focus group, Qualitative techniques, *Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:**Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report, Case Study**.**

References:-

1. Excel 2016 for Dummies; Greg Harvey; ISBN: 9788126558964
2. Microsoft Excel Power Pivot & Power Query for Dummies; Michael Alexander; ISBN: 9788126562305
3. Microsoft Excel Formulas & Functions for Dummies, 4ed; Ken Bluttman; ISBN: 9788126559466
4. Excel Data Analysis: Your visual blueprint for creating and analysing data, charts and PivotTables, 3rd Edition; Denise Etheridge; ISBN: 978-1-118-03623-5
5. Monetizing Your Data: A Guide to Turning Data into Profit-Driving Strategies and Solutions; Andrew Roman Wells, Kathy Williams Chiang; ISBN: 978-1-119-35625-7
6. Excel2016 for Beginners
7. Excel Pivot Table Champion: How to Easily Manage and Analyze Giant Databases with Microsoft Excel Pivot
8. Microsoft Excel Practical Formulae: From Basic Data Analysis to Advanced Formulae Manipulation

COURSE 03

Discipline/Programme	Computer Science
Semester	I/ II
Type of Course	DSC
Course Code	24UCAPDSC105
Course Title	**Information Technologies**
Course Level	100-199
Course Summary	The goal of this course is to present overview of Operating system, database, networks and programming
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain basic concepts of Computers	Understand	PO1, PO2, PO8
2	Analyse the concepts of operating system and Linux	Apply	PO1,PO2, PO8
3	Describe the concepts of database and fundamental queries	Apply	PO1,PO2, PO8
4	Analyse the concepts of data communication, , topology, categories of network, protocols, transmission modes,	Apply	PO8,PO2,PO1

COURSE CONTENT

Module	Units	Description	Hrs	CO
	Computer Fundamentals (15 hours)			
1	1.1	Information Technology Basics- Need for Information Storage and Processing	5	CO1
	1.2	Information Technology Components , Role of information Technology	5	CO1
	1.3	Generation of computers, Functional Units, Primary and secondary memory, storage devices	3	CO1
	1.4	Computer Software: System Software, Applications Software	2	CO1
2	Operating System(7 hours)			
	2.1	Operating Systems: Objectives and functions, OS Services	2	CO2
	2.2	Types of OS	2	CO2
	2.3	Linux Introduction, Commonly Used Commands	3	CO2
3	Programming and Database Concepts (9 hours)			
	3.1	Introduction to Algorithms and Programming Languages: Algorithm, Principles of flowcharting, Flowcharting symbols, Converting algorithms to flowcharts ,Control Structures, Pseudo code.	3	CO3
	3.2	Programming Languages, Generations of Programming Languages.	3	CO3
	3.3	Introduction: Characteristics of database approach, Database users-DBA, Database designers and end users, Advantages of using DBMS. Data Models, Three-Schema Architecture, Components of DBMS, DBMS language	2	CO3
	3.4	SQL Queries- DDL and DML Commands	1	CO3
	Computer Networks (13 hours)			
	4.1	Computer Networks: Introduction, Types of networks	4	CO4

4	4.2	Network Topologies, Networking Devices- Switch, Hub, Repeater, Gateway, Router, protocol	2	CO4
	4.3	Transmission Media, Network Security	3	CO4
	4.4	Emerging Computer Technologies	4	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. P. K. sinha, Computer Fundamentals
2. Anita Goel, ComputerFundamentals
3. V. Rajaraman, Fundamentals of Computers
4. E. Balagurusamy, Fundamentals of Computers

COURSE 04

Discipline/Programme	Computer Science
Semester	I/II
Type of Course	DSC
Course Code	24UCAPDSC106
Course Title	**Fundamentals of Business Analytics with Python**
Course Level	100-199
Course Summary	Upon completion of this Python Data Analytics course, students will proficiently manipulate and analyze large datasets using Python's powerful libraries such as Pandas, NumPy, and Matplotlib. Through hands-on projects and real-world applications, learners will develop the skills to extract actionable insights, visualize data effectively, and communicate findings to diverse stakeholders. By mastering these techniques, students will be well-equipped to tackle complex data analytics challenges, drive data-informed decision-making, and excel in various industries ranging from finance to healthcare.
Lecture/Tutorial/Practical Hours	25/20/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To Explain the basics of Python and installation of Python	Understand	PO1
2	To comprehend control flow structures such as loops conditional statements (if, elif, else), and how to use them effectively in programming logic	Understand	PO1, PO2
3	to define functions, understand their scope, pass arguments, and return values, facilitating code modularity and reusability.	Apply	PO3

4	To Apply data handling , data cleaning and treatment techniques using python	Analyse	PO2
5	Applying statistical models for data interpretation in Python	Create	PO2, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Installing Python			
	1.1	Installing Python,, Basic input and output , Variables and assignments , Identifiers, objects	5	CO1
	1.2	Common data types summary, Type conversions, Binary numbers, String formatting	5	CO1
2	Understanding control flow			
	2.1	If-else branches, Equality and relational operators, Boolean operators and expressions, identity operators, Code blocks and indentation	5	CO2
	2.2	Conditional expressions Loops, While loops, For loops, Nested loops, Break and continue, Loop else	5	CO2
	2.3	User-defined function basics, returning values from functions, Reasons for defining functions, Function arguments	8	CO2
3	Pivot Tables and Charts			
	3.1	Important packages in Python	5	CO3
	3.2	Data handling in Python, Data cleaning and Treatment	5	CO4

4	Applications of Statistics in Python			
	4.1	Performing Descriptive statistics in Python, using graphs and plot in Python, central tendency measure, graphical measure	7	CO5
5	**5.1**	Practical	30	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, Laboratory record, Computer lab work, Practical based assessment, Viva, Any *other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

References:-

1. Data Analytics using Python (Paperback) By: Bharti Motwani (Author) | Publisher: Wiley
2. Data Analytics using Python (Paperback) By: Dr R K Lakshmi (Author) | Publisher:

COURSE 05

Discipline/Programme	Computer Science
Semester	I/II
Type of Course	DSC
Course Code	24UCAPDSC107
Course Title	**Foundations of Digital Literacy**
Course Level	100 – 199
Course Summary	This ICT course provides a comprehensive exploration of fundamental concepts such as information technology, hardware, software, and operating systems. It then delves into various network types, emphasizing their benefits, topologies, and security measures like firewalls. The module on security addresses internet threats and emerging technologies like AI, IoT, and blockchain. Additionally, practical applications of MS Word and Excel, including document creation, mail merge, and charting, are covered. The course wraps up with PowerPoint, ensuring students acquire practical skills essential for navigating the digital landscape.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Discussing students' knowledge in ICT	Understand	PO3
2	Analyse the scope of Internet	Analyse	PO7
3	Assessing Security and privacy in internet	Analyse	PO7
4	Create Word Documents	Create	PO8
5	Create Spreadsheet documents	Analyse	PO8
6	Create Presentations	Analyse	PO8

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	**Module 1: Introduction to ICT (6 hrs)**			
	1.1	**ICT -**Information Technology, Hardware and Software, Components and functions: Input, Processing, Storage, Output and Communication Hardware.	3	CO1
	1.2	**Software –** Software: System software and Application Software – Operating System: WINDOWS, UNIX and LINUX.	3	CO1
2	**Module 2: Networks and Internet (11 hrs)**			
	2.1	**Types of Networks** - Computer Networks – Meaning, Types of Networks: WAN, MAN, LAN, PAN, CAN. Benefits of Networks, Network Topology.	3	CO2
	2.2	**Application** - Work group Computing & Groupware – Telecommuting and Virtual Offices	3	CO2
	2.3	**Network Security** - Network Security – Firewalls. Communication Medium: Wired and Wireless.	5	CO2
3	**Module 3: Security and Privacy (8 hrs)**			
	3.1	**Internet Threats** – Threats, Types of Threats, Client level threats, Server level threats and Communication channel level threats.	3	CO3
	3.2	**Security Measures** - Client level Security Measures, Server level Security Measures and Communication channel Security Measures	3	CO3
	3.3	Emerging Technologies – Trends like AI, IOT and Blockchain	2	CO3
4	**Module 4: Practical Applications of MS Word and MS Excel (18 hrs)**			

	4.1	**Creation of a Word Document**- Introduction to Word – Components, application of formatting, find and replace and creation of Tables.	4	CO4
	4.2	**Mail Merge** – Preparation of Letters.	4	CO4
	4.3	**Ms Excel** – Introduction, Components, worksheets and workbook, preparation of Payroll and Marksheet.	5	CO4
	4.4	**Charts** – Creating charts to present data	5	CO4
5	**Module 5: Power Point (32 hrs)**			
	5.1	**Power Point** – Introduction, Meaning, Components, Benefits.	2	CO5
	5.2	**Preparing a Presentation**– Slide, Layout, Slide transition, Animation.	10	CO5
	5.3	**Adding Objects** – Inserting tables, pictures, videos, charts etc.	10	CO5
	5.4	**Presentation** – Rehearsing Slide show, Slideshow.(Seminar with presentation by each student on any general topic)	10	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, , Laboratory record, *Any other method as may be required for specific course by the course faculty*.

	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

References:

- Using Information Technology (6thEdition): Williams & Sawyer Tata McGraw Hill Company
- Operating System Concepts (Windows XP update): AviSilberschatz, Peter Galvin & Greg Gagne Willey
- Computer Networks Protocols, Standards and Interface: Uyless Black Prentice Hall India Pvt. Ltd.
- Web Design Technology Theory and Techniques on the cutting edge: D.P. NagpalS. Chand& Company
- HTML Black Book: Stephen Holzner Dreamtech Press
- Web Technologies: Achyut S. Godbole & AtulKahate Tata McGraw Hill Company.
- Using the Internet: Barbara Kasser Prentice Hall of India Pvt. Ltd.
- The Complete Reference on Internet: Margaret Lavine Young Tata McGraw Hill Edition.
- How to do everything with HTML & XHTML A beginners Guide:James Pence Dreamtech Press

COURSE 06

Discipline/Programme	Computer Science
Semester	III/IV
Type of Course	DSC
Course Code	24UCAPDSC207
Course Title	**Problem Solving Techniques**
Course Level	200-299
Course Summary	This course covers fundamental concepts in computer programming, including algorithms, flowcharts, programming languages, control flow structures, arrays, and functions, emphasizing practical implementation through a series of hands-on exercises. Students will gain proficiency in solving problems using the C programming language..
Lecture/Tutorial/Practical Hours	45/0/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO**
1	Describe the fundamentals of computing and problem-solving tools and techniques.	Understand	PO1, PO2
2	Illustrate the basics of programming using C language.	Understand	PO1,PO2
3	Apply C data structures and control structures in programming.	Apply	PO2,PO1
4	Apply logic in designing solutions to various problems using C Language.	Apply	PO8, PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Computing and problem solving(8 hours)			
	1.1	Basics of Computing- Bit, Byte, Data, and Information-Computer as a Data Processing machine-Computer Programs and Software-System and Application Software.	2	CO1
	1.2	Problem Solving Life Cycle (Software Development Method) – Specify the problem requirements - Analyze the problem- Design the algorithm - Implement the algorithm-Test and verify the completed program-Maintain and update the program.	2	CO1
	1.3	Understanding basic Problem-Solving Tools: Algorithms and Flowcharts- Examples.	2	CO1
	1.4	Problem solving approaches: Top-down approach, Bottom-up approach- Structured programming concepts.		
	1.5	Computer Programming-Classification of Computer languages- Machine, Assembly and High-level languages, Language translators, Debugging, Types of errors- Syntax errors, Logical errors and Runtime errors.	2	CO1
2	Introduction to Programming (5 hours)			
	2.1	Introduction to C Programming: Character Set, Structure of a 'C' Program, Identifiers and keywords, Data Types, Variables, Constants, Operators, Expressions.	2	CO2
	2.2	Input and Output in C – Formatted functions, unformatted functions, commonly used library functions.	3	CO2
3	Strings, Functions, Storage Classes and Pointers (13 hours)			
	3.1	Decision Statements- If, if-else, nested if-else, if-else-if ladder. Multi Branching Statement (Switch), Break and Continue, Unconditional Branching (Go to Statement).	3	CO3
	3.2	Loop control- for loops, nested for loops, while loops, do while loop. Nested Looping statements.	3	CO3
	3.3	Arrays: Declaration and Initialization of one and two-dimensional arrays, Strings.	3	CO3

	3.4	Functions: Definition-Declaration-Prototypes and Function call- actual and formal arguments.	4	CO3
4	User Defined Data types and File Management (19 hours)			
	4.1	Simple C programs	4	CO4
	4.2	Program to illustrate control statements, Switch statement	4	CO4
	4.3	Program to illustrate looping statements	5	CO4
	4.4	Program to illustrate arrays	3	CO2
	4.5	Program to illustrate functions and user-defined functions	3	CO4

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. Practical: *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.

	B. End Semester Examination (ESE) Theory: *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* Practical: *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. C Programming Absolute Beginner's Guide by Greg Perry and Dean Miller.
2. The C Programming Language by Brian W. Kernighan
3. Programming in ANSI C by E Balagurusamy

COURSE 07

Discipline/Programme	Computer Science
Semester	III/IV
Type of Course	DSC
Course Code	24UCAPDSC208
Course Title	**Business Intelligence and Data Visualization using Power BI**
Course Level	200-299
Course Summary	This course offers a comprehensive introduction to the principles and practices of business intelligence (BI) and data visualization. Participants will explore the fundamental concepts of BI, as well as the role of data visualization in transforming raw data into actionable insights. Through a combination of theoretical lectures, and practical knowledge on data visualization through POWER BI. Students will develop the skills and knowledge necessary to harness the power of BI tools and create compelling visualizations that drive informed decision making in organizations
Lecture/Tutorial/Practical Hours	25/20/30
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	The student will be able to explain the concept of data visualisation	Understand	PO1, PO3
2	To create Interest in the latest trends in data visualisation	Interest	PO3
3	To Identify different types of data used in analytics	Understand	PO1
4	To apply the story telling technique in data visualisation	Apply	PO2, PO3
5	To develop data visualisation using Power BI	Create	PO3, PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO No
1	Introduction to data visualisation			
	1.1	Data visualization Introduction - The data visualization process- Filtering & processing - Translation & visual representation - Perception & interpretation	3	CO1
	1.2	Importance of data visualisation in reports and statements - key aspects of reports and statements	3	CO1
2	Trends in data visualisation			
	2.1	Trends in Data Visualization -Storytelling	3	CO2
	2.2	Trends in Data Visualization—Interactive Graphics	3	CO2
	2.3	Visualization Designers - Uses of Data Visualization	3	CO2
	2.4	How Do You Incorporate the Visualization Process into Practice	3	CO4
3	Types of Data			
	3.1	Different types of data	3	CO3
	3.2	Quantitative (numeric) -Discrete – Continuous - Qualitative (categoric)- Ordinal -Categorical	3	CO3
	3.3	Data relationships -Ranking -Deviation- Correlation- Distribution- Partial and total relationships -Nominal comparisons -Series over time	4	CO3
4	Storytelling for social and market communication			
	4.1	Stories to communicate insight – simple sequences for telling story – influencing	3	

		people's emotions and incorporating benefits/engagements / Call to action		CO5
	4.2	Three key elements – Data narrative and visualisation	3	CO5
	4.3	Successfully using our data to tell a story, wield influence, and effect the desired change	4	CO5
	4.4	A basic recipe for storytelling in your presentations and final reports -Find the story in your data.-Define the perspective.-Create a hierarchy -Organize.	4	CO5
	4.5	Plot.-Use data to anchor your narrative - Design principles -Review, review, review - Be familiar with your content and respect your audience-Keep it short and sweet.	3	CO5
5	**5.1**	Practical Power BI	30	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty.* **Practical:**

	Observation of practical skills, Laboratory record, Computer lab work, Practical based assessment, Viva, Any *other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

References: -

1. Excel Dashboards & Reports for Dummies, 2ed (Author - Michael Alexander (Frisco); ISBN: 978- 1- 118-84242-3
2. Microsoft Data Analytics for Dummies; Jared Decker, Brian Henry, Rob Sickorez; ISBN: 978-1- 119- 69636-0
3. Tableau for Dummies; Molly Monsey, Paul Sochan; ISBN: 978-1-119-13483-1
4. Data Visualization For Dummies, Mico Yuk, Stephanie Diamond; ISBN: 978-1-118- 50292-1
5. Excel Data Analysis: Your visual blueprint for creating and analysing data, charts and PivotTables, 3rd Edition; Denise Etheridge, ISBN: 978-1-118-03623-5
6. Storytelling with Data: A Data Visualization Guide for Business Professionals by Cole Nussbaumer
7. Storytelling with Data: A Data Visualization Guide for Business Professionals
8. High Impact Data Visualization in Excel with Power View, 3D Maps, Get & Transform and Power BI2nd ed. Edition by Adam
9. Data Visualization & Presentation with Microsoft Office 1st Edition (Paperback)by Valerie M.

Course 08

Discipline/Programme	Computer Science
Semester	III/IV
Type of Course	DSC
Course Code	24UCAPDSC209
Course Title	**Internet and Web Technologies**
Course Level	200-299
Course Summary	The course covers the fundamentals of computer networks, including types, topologies, communication mediums, networking tools, security, and an introduction to the Internet, HTML, and webpage design.
Lecture/Tutorial/Practical Hours	45/0/30
Credits	3
Pre-requisite, if any	Basic knowledge in HTML tags Knowledge of basic computer hardware and software

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe the fundamentals of computer networks and Internet.	Apply	PO1,PO2,PO8
2	Illustrate basic HTML tags for webpage designing.	Analyze	PO1,PO2,PO8
3	Design websites using HTML tags.	Evaluate	PO1,PO2,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Computer networks and Internet(15 hrs)			
	1.1	Computer Networks –Types of Networks: WAN, MAN, LAN, PAN, CAN- Benefits of Networks.	2	CO1
	1.2	Network Topology –Bus, Ring, Star, Tree, Mesh, Hybrid- Communication Medium: Wired and Wireless.	4	CO1
	1.3	Networking Tools- MODEM, Repeater, Hub, Switches, Routers, Bridge, Gateway- Network Security –Firewalls.	3	CO1
	1.4	Internet - History, Benefits and Drawbacks, Internet Protocols: TCP/IP, FTP, HTTP, IP Address, Domain Name System (DNS), URL.	3	CO1
	1.5	Web Browsers, WWW, Search Engines – Types, Academic Search Techniques - Applications of Internet.	3	CO1
2	HTML and Webpage(15 hrs)			
	2.1	Introduction to HTML – Essentials- Static & Dynamic Web Pages - Structure of a Web Page	2	CO2
	2.2	Designing Web Pages- HTML Tags -Text Formats- Working with Text- Presenting and Arranging Text- Paragraphs- Animated Effects: Marquee – using White Space.	5	CO2
	2.3	Tables in HTML Working with Links	4	CO2
	2.4	Lists, Images, Thumbnails, Audio & Video-Forms & Frames.	4	CO2

3	Lab Practice: (Webpage designing) 30 hrs			
	3.1	Text Formatting: Create a webpage demonstrating various text formatting options such as bold, italics, underline, strikethrough, and superscript/subscript using HTML tags.	6	CO3
	3.2	Lists: Develop a webpage showcasing different types of lists (unordered, ordered, and definition lists). Experiment with nested lists.		
	3.3	Tabular Presentation: Build a webpage illustrating the use of HTML tables for organizing data. Explore table attributes for modifying cell spacing, padding, borders, and alignment. Incorporate colspan and rowspan attributes for complex table layouts.	6	CO3
	3.4	Form Creation: Construct a webpage containing a form with various input elements such as text fields, checkboxes, radio buttons, select dropdowns, and text areas.	6	CO3
	3.5	Frame Integration: Design a webpage with multiple frames using the <frame> and <frameset> tags. Experiment with different frame configurations such as rows, columns, and nested frames. Showcase the use of the <noframes> tag for browsers that do not support frames.	6	CO3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:**

	Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty.* **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References

Raj Kamal, "Internet & Web Technologies", Tata McGraw Hill.

SUGGESTED READINGS:

Thomas. A. Powell, "HTML & CSS: The Complete Reference", 5th Edition, Tata McGraw Hill.

Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Pearson.

6. SYLLABUS FOR MULTIDISCIPLINARY COURSES

COURSE 01

Discipline/Programme	Computer Science
Semester	1
Type of Course	MDC
Course Code	24UCAPMDC101
Course Title	**Computer Hardware and Assembling**
Course Level	100-199
Course Summary	This course enables the students to understand the fundamentals of PC assembly and provide a thorough understanding of the components required to build a PC from scratch
Lecture/Tutorial/Practical Hours	30/0/30
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	To Learn the basics of computer generations and hardware components.	Understand	PO1, PO2
2	Demonstrate basic working principles of computer hardware components.	Analize	PO1, PO2
3	Perform PC assembling and installation and basic memory Concepts	Analize	PO1, PO2 PO8
4	Illustrate the concept of input and output devices of Computers.	Apply	PO1, PO2

COURSE CONTENTS

Module	Units	Description	Hours	CO No
Introduction to Computers(6 hrs)				
1	1.1	Generations of Computer (I-V),Classification of Computers: Analog, Digital and Hybrid Computers, Micro, Mini, Mainframe, Super Computers, Servers, Laptop	2	CO1
	1.2	Block Diagram of a Computer, Functions of the Different Units: Input unit, Output unit, Memory unit, CPU (ALU+CU).	2	CO1
	1.3	Booting Process- POST, BIOS, clock speed, memory speed, memory capacity	2	CO1
Introduction to Computer Hardware(9 hours)				
2.	2.1	Introduction to Computer Hardware, DC regulated power supply- Block Diagram	3	CO2
	2.2	Concepts of Switch Mode Power supply	2	CO2
	2.3	Inverters, UPS and their applications.	2	CO2
	2.4	Basic Components of CPU, Mother Board.	2	CO2
Expansion Slots(10 hours)				
3.	3.1	ISA,EISA, MCA, VESA, PCI local bus,	2	CO3
	3.2	Processor, Connectors, CMOS memory	2	CO3
	3.3	SMPS, Serial and Parallel Ports, USB, BIOS chip	3	CO3
	3.4	Steps for assembling a PC	3	CO3
Memory(10 hours)				

4.	4.1	Primary Memory, RAM- SRAM, DRAM, ROM, PROM, EPROM, EEPROM, flash memory,	2	CO3
	4.2	Secondary memory: Hard Disk: Structure of a hard disk	2	CO3
	4.3	how data is stored in a hard disk, concept of tracks, sectors, clusters, cylinders	2	CO3
	4.4	CD-R, RW, DVD-RW, Blue-ray disk, HVD	2	CO3
	4.5	PC memory Units: SIMM, DIMM, RIMM.	2	CO3
Input Devices & O/P Devices(10 hours)				
5.	5.1	Keyboard, Point and draw devices: mouse, joystick, track ball, light pen, Data Scanning devices: image scanner, OCR, OMR, MICR, Bar code reader, Voice Recognition Device: Microphone	5	CO4
	5.2	Output Devices: Monitor- CRT displays, Non-CRT displays, TFT: LED,LCD, Plasma. Printer, Impact and non-impact, Character, line and Page Printers.	5	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Peer Teaching, Discussion-based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.

References:

1. Pradeep Sinha and Priti Sinha - Computer Fundamentals, Fourth Edition- 2007, BPB Publications

2. B. RAM, "Computer Fundamentals: Architecture and Organization", New age international (P) Limited.

COURSE 02

Discipline/Programme	Computer Science
Semester	I
Type of Course	MDC
Course Code	24UCAPMDC102
Course Title	**Cyber Laws and Online safety**
Course Level	100-199
Course Summary	This comprehensive course on Cyber Laws, IT Act, and Online Security is designed to provide participants with a thorough understanding of the legal and security aspects in cyberspace. By the end of this course, participants will not only have a comprehensive understanding of cyber laws, cybercrimes, and online security but will also possess practical skills to navigate the digital realm safely and responsibly.
Lecture/Tutorial/Practical Hours	30/0/30
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe cyber laws, IT Act, data protection, cybercrimes, cyber bullying, and harassment laws effectively.	Understand	PO1, PO4, PO6
2	Analyse internet security, passwords, browsing, social media, transactions.	Analyse	PO2, PO5, PO6
3	Apply the acquired knowledge on cyber laws, IT security measures, and ethical considerations in real-world scenarios to safeguard digital information.	Apply	PO 3, PO7, PO8
4	Utilize basic tools and technologies to protect their devices to secure information and safe use of technology.	Apply	PO2, PO5

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	**Cyber Laws, IT Act and Cyber Crimes (19 hours)**			
	1.1	Introduction to Cyber laws: Definition and Scope,Key legal concepts in cyber space.	2	CO1
	1.2	IT Act : Overview of the IT Act 2000, Offenses and penalties under the IT Act, Amendments and evolving landscape.	4	CO1
	1.3	Data Protection and Privacy Laws : Principles ofData Protection, Privacy laws and regulations.	3	CO1
	1.4	Cyber Crimes: Types of Cybercrimes, Hacking andunauthorized access, Identity theft and cyber fraud.	4	CO1
	1.5	Cyber Bullying and Harassment: Definition and Forms of Cyber Bullying, Legal Perspective on Cyber bullying.	4	CO1
	1.6	Harassment Laws and social media, Reporting andpreventing cyber bullying.	1	CO1
2.	**Online Security (10 hours)**			
	2.1	Introduction to Internet Security: Overview of Internet Security, Importance of Online Safety.	2	CO2
	2.2	Passwords and Authentication: Importance of Strong Password, Multi Factor Authentication (MFA).	2	CO2
	2.3	Secure Browsing Practices: Recognizing and Avoiding phishing Attacks, Identifying Secure Websites (HTTPS).	2	CO2
	2.4	Social Media Security: Privacy settings on Social media platforms, Secure sharing information.	2	CO2
	2.5	Online Transaction and Financial Security: Secure online shopping, Banking and Financial Security, Payment Card safety.	2	CO2
3.	**Practical Applications of Cyber Laws Hours and Online Safety (25 hours)**			

	3.1	Case Analysis: Assign students a cyber law case to analyze. They should present a summary of the case, identify key legal concepts involved, and discuss the offenses and penalties under the IT Act that are relevant to the case.	5	CO3
	3.2	Legislation Review: Ask students to review recent amendments to the IT Act and research how these changes impact the legal landscape. They should present their findings and discuss the evolving nature of cyber laws.	5	CO3
	3.3	Cybersecurity Incident Response Plan: Ask students to create a basic incident response plan for a hypothetical organization. This should include steps to take in case of hacking, unauthorized access, or a cybersecurity incident.	5	CO3
	3.4	Password Security Audit: Students should conduct a password security audit for their personal accounts. They should evaluate the strength of their passwords, implement multi-factor authentication where possible, and suggest improvements.	5	CO3
	3.5	Phishing Awareness Campaign: Task students with creating a phishing awareness campaign. Secure Online Transactions: Ask students to research and compile a guide on best practices for secure online transactions. This should cover topics such as secure online shopping, banking, and payment card safety.	5	CO3
4	**Digital Devices Security, Tools and Technologies for Cyber Security (6 hours)**			
	4.1	End Point device and Mobile phone security, Password policy, Security patch management, Data backup	2	CO4
	4.2	Downloading and management of third party software, Device security policy	2	CO4
	4.3	Cyber Security best practices, Significance of host firewall and Anti-virus, Management of host firewall and Anti-virus	1	CO4
	4.4	Wi-Fi security, Configuration of basic security policy and permissions	1	CO4

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Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. Any other method as may be required for specific course by the course faculty.
Practical:
Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.</td></tr>
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Theory:
Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.
Practical:
Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.</td></tr>
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References:

1. Vakul Sharma, “Information Technology Law and Practice”, 3rd ed. 2011, Universal Law Pub., New Delhi.
2. Adv. Prashant Mali, “Cyber Law & Cyber Crimes”, Snow White Publications Pvt. Ltd, 2nd ed. 2015.
3. Michael Cross , “Social Media Security: Leveraging Social Networking While Mitigating Risk”, Elsevier, 2014.
4. William Stallings & Lawrie Brown “ Computer Security – Principles and Prctice” 3rd ed., Pearson Pub., 2017.
5. Cyber Crime Impact in the New Millennium, by R. C Mishra, Author Press. Edition 2010.

6. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011).
7. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson, 13th November, 2001).
8. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
9. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
10. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
11. Fundamentals of Network Security by E. Maiwald, McGraw Hill

COURSE 03

Discipline/Programme	Computer Science
Semester	II
Type of Course	MDC
Course Code	24UCAPMDC103
Course Title	**Basic IT Tools**
Course Level	100-199
Course Summary	This course provides a comprehensive introduction to the key office productivity tools, including Microsoft Word, Excel, PowerPoint, and Access. Designed for beginners, the course covers the essential features and functions of each software, empowering students with the skills needed for efficient document creation, data analysis, presentations, and database management.
Lecture/Tutorial/Practical Hours	30/0/30
Credits	3

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO**
1	Understand the basics of word processing	Understand	PO1,PO2,PO8
2	Demonstrate various operations in MS Excel.	Apply	PO1,PO2,PO8
3	Prepare and manage professional presentation in MS PowerPoint	Apply	PO1,PO2,PO8
4	Develop proficiency in MS Access for database management.	Apply	PO1,PO2,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	**Introduction to Word Processing (7 hours)**			
	1.1	Introduction to Computers- Hardware and Software- Installation	2	CO1
	1.2	Introduction to Word Processing (MS Word 2016) -Creating, Saving, Formatting techniques, Page set up and sections- setting page margins, headers and footers, page borders, working with tables, spell check and Mail merge	5	CO1
2	**Introduction to Spreadsheets (10 hours)**			
	2.1	Introduction to MS Excel 2016 - Concept of worksheets and workbooks, working with multiple worksheets and multiple workbooks	2	CO2
	2.2	Understanding absolute, relative and mixed referencing in formulas, referencing cells in other worksheets and workbooks, correcting common formula errors, working with inbuilt function categories like mathematical, statistical, text, lookup, information, logical, database, date and time and basic financial functions.	3	CO2
	2.3	Choosing a chart type, understanding data points and data series, editing and formatting chart elements	2	CO2
	2.4	Analysing data using pivot tables: Creating, formatting and modifying a pivot table, sorting, filtering and grouping items, creating calculated field and calculated item, creating pivot table charts, producing a report with pivottables.	3	CO2
3	**Introduction to MS PowerPoint 2016 (7hours)**			
	3.1	Create and Manage Presentations - Create a Presentation Insert and Format Slides, modify Slides, handouts, and notes, change presentation options and views, configure a presentation for Print, configure and present a slide Show	2	CO3
	3.2	Insert and Format Text, Shapes, and Images - Insert and Format Text, Insert and Format Shapes and Text Boxes, Insert and Format Images, Order and Group Objects	2	CO3

	3.3	Insert Tables, Charts, SmartArt, and Media - Insert and Format Tables, Insert and Format Charts, Insert and Format SmartArt graphics, Insert and Manage Media	2	CO3
	3.4	Apply Transitions and Animations - Apply Slide Transitions Animate Slide Content, Set Timing for Transitions and Animation	1	CO3
4	**Introduction to Databases (6 hours)**			
		MS Access 2016 : Overview - Managing and Creating Tables Creating Relationships between Tables - Performing Queries IV. Creating and Modifying Tables in Design View - Creating Forms - Creating Reports and Mailing Labels - Modifying, Filtering, and Viewing Data - Importing and Exporting Data	6	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty*.
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References

1. Wang, W. (2018). Office 2019 For Dummies. United States: Wiley. Microsoft
2. Lambert, J. (2019). Microsoft Word 2019 Step by Step. United States: Pearson Education.
3. Wang, W. (2018). Office 2019 For Dummies. United States: Wiley. Microsoft Lambert, J. (2019). Microsoft Word 2019 Step by Step. United States: Pearson Education
4. Alexander, M., Kusleika, R. (2018). Access 2019 Bible. United Kingdom: Wiley
5. Benchmark Series: Microsoft Access 2016 with SNAP and eBook Authors: Rutkosky, Davidson, Roggenkamp, Rutkosky ISBN-13: 978-0-76386-997-7

Course 04

Discipline/Programme	Computer Science
Semester	III
Type of Course	MDC
Course Code	24UCAPMDC201
Course Title	**Web Designing**
Course Level	200-299
Course Summary	It enables students to learn various techniques, tools and programming languages in order to create and maintain web pages. The web designing course syllabus contains a basic introduction to designing a website, its tools, software applications, and themes
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3
Pre-requisite, if any	Basic knowledge in HTML tags Knowledge of basic computer hardware and software

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify the elements of HTML	Apply	PO1,PO2,PO8
2	Understand the basic concept of CSS	Analyze	PO1,PO2,PO8
3	Develop the concept of web publishing	Evaluate	PO1,PO2,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Hyper text Markup Language (10 hours)			
	1.1	HTML, HTML documents, Basic structure of an HTML document, Creating an HTML document, Markup tags, heading, paragraphs, Line breaks, HTML tags	4	CO1
	1.2	Elements of HTML: Introduction, Working with Text, Working with list, tables, and frames.	4	CO1
	1.3	Working with Hyperlinks, images and Multimedia	2	CO1
2	Adding Stylesheets (12 hours)			
	2.1	Introduction to CSS: Creating style sheet, CSS properties, CSS styling, working with block elements and objects, working with Lists and Tables, CSS Id and Class	4	CO2
	2.2	Box Model- Introduction, Border properties, Padding, Properties, Margin Properties	4	CO2
	2.3	Applying CSS to HTML,CSS colors and Backgrounds	4	CO2
3	Publishing Websites (8 hours)			
	3.1	Introduction to Web publishing or Hosting	2	CO3
	3.2	Creating the website, Saving and working on the website	3	CO3
	3.3	Creating website structure, Creating Titles for web pages, Themes- Publishing websites.	3	CO3

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References

1. HTML 5 in simple steps, Kogent Learning Solutions, Dreamtech Press
2. A Beginner's guide to HTML, NCSA
3. HTML,XHTML and CSS bible, Steven M. Schafer, Wiley India
4. Beginning HTML, XHTML, CSS and JavaScript, Wiley India
5. Beginning CSS: Cascading Style Sheets for Web Design, Ian Pouncey, Richard York, Wiley India
6. Web Technologies: HTML, JavaScript, Kogent Learning, Wiley India

7. SYLLABUS FOR SKILL ENHANCEMENT COURSES

COURSE 01

Discipline/Programme	Computer Science
Semester	IV
Type of Course	SEC
Course Code	24UCAPSEC201
Course Title	**Advanced Excel**
Course Level	200-299
Course Summary	Gain the skills to analyze data and automate tasks for maximum efficiency..Whether you're a beginner or looking to refine your existing knowledge, this course will guide you through all the essential features for efficient data management, analysis, and visualization.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Build flexible spreadsheets and perform calculations effectively	Apply	PO1,PO2
2	Explain conditional formatting to highlight specific data points and analyse complex data	Apply	PO1,PO3,PO2
3	Summarize and analyse large dataset and visualize data using charts and graphs	Analyse	PO1,PO3,PO2
4	Develop spreadsheet with macros and mastering Spreadsheet Navigation and Manipulation	Apply	PO1,PO2,PO7,PO8

COURSE CONTENT

Module	Units	Description	Hours	CO No
1	Introduction to Excel (8 hours)			
	1.1	An Overview of the Screen, Navigation and Basic Spreadsheet Concept, Various Selection Techniques ,Data Entry - Creating, Editing, Saving, Page Settings.	2	CO1
	1.2	Functions & Formulas, Basic Functions, Lookup Functions, Logical If Functions, Date & Time functions, Financial Functions, Statistical Functions, Maths & Trig. Functions, Text Functions.	6	CO1
2	Data Handling(7 hours)			
	2.1	Conditional Formatting, Sort & Filter, Data Validation.	4	CO2
	2.2	Data Tools, Subtotal and What if Analysis.	3	CO2
3	Analysis and Visualization (11 hours)			
	3.1	Creating Charts, Different types of Chart, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table.	6	CO3
	3.2	Creating PivotTables, Manipulating a PivotTable, Using the PivotTable Toolbar, Changing Data Field, Properties, Displaying a PivotChart, Setting PivotTable Options, Adding Subtotals to PivotTables.	5	CO3
4	Spreadsheet Navigation & Management (4 hours)			
	4.1	Moving between Spreadsheets, Selecting Multiple Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding, Protecting worksheets.	2	CO4
	4.2	Recording Macros, Running Macros, Deleting Macros.	2	CO4

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References:

1. Microsoft Excel Data Analysis and Business Modeling (Office 2021 and Microsoft 365), 7th Edition by Wayne Winston
2. Jelen, B. (2013). Excel 2013 Charts and Graphs. United Kingdom: Que.
3. Alexander, M., Jelen, B. (2013). Excel 2013 Pivot Table Data Crunching. UnitedKingdom: Pearson Education.
4. Excel Macros for Dummies by Michael Alexander
5. https://www.tcworkshop.com/data/Downloads/TCW_Courseware/Excel/DataAnalysis.pdf
6. https://www.w3schools.com/excel/index.php

COURSE 02

Discipline/Programme	Computer Science
Semester	V
Type of Course	SEC
Course Code	24UCAPSEC301
Course Title	**AI Tools**
Course Level	300-399
Course Summary	An AI tool is a software application that uses artificial intelligence algorithms to perform specific tasks and solve problems. AI tools can be used in a variety of industries, from healthcare and finance to marketing and education, to automate tasks, analyze data, and improve decision-making.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Learn the concept of LLMs and their impact on various fields and analyze the strengths and limitations of ChatGPT compared to other LLMs.	Understand	PO2, PO4, PO8
2	Understand AI tools to enhance personal and professional productivity.	Understand	PO4, PO5, PO8
3	Develop ChatGPT and AI tools in a real-world project, showcasing your creativity and problem-solving skills.	Apply	PO1, PO2, PO6

COURSE CONTENT

Module	Units	Description	Hrs	CO
1.	Introduction to ChatGPT and Large Language Models (LLMs) (10 hours)			
	1.1	Understanding LLMs: Fundamentals of LLMs, its history, architecture, core functionalities.	3	CO1
	1.2	ChatGPT: Capabilities of ChatGPT, its strengths, limitations, ethical considerations.	3	CO1
	1.3	Interacting with ChatGPT: Art of prompting and querying ChatGPT to achieve desired outcomes in various creative and informative tasks.	4	CO1
2.	Exploring the AI Tool Landscape (10 hours)			
	2.1	AI for Content Creation: AI tools for writing, storytelling, poetry generation, code writing, and design.	3	CO2
	2.2	AI for Productivity: Explore tools for automation, scheduling, data analysis, research, and personal project management.	3	CO2
	2.3	AI for Communication: Uncover tools for translation, video conferencing, and virtual assistants.	4	CO2
3.	Putting AI Tools to Work: Project-Based Learning (10 hours)			
	3.1	Choose your project: Select a project based on your personal interests, focusing on creative applications or practical problem-solving.	3	CO3
	3.2	Design and implement: Apply your new found knowledge of ChatGPT and AI tools to bring your project to life.	3	CO3
	3.3	Share and reflect: Present your project to the class, discuss challenges and learnings, and provide feedback on your peers' work.	4	CO3

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</table>

References:

1. Bender, E. M., Gebru, T., Mitchell, M., & Friedman, D. (2021). On the dangers of stochastic parrots: Can language models be too big? Proceedings of the National Academy of Sciences, 118(45), e2100478.
2. Russell, S. J., & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson.

Additional References

1. Stanford Encyclopedia of Philosophy. (n.d.). Artificial intelligence https://plato.stanford.edu/entries/artificial-intelligence/

COURSE 03

Discipline/Programme	Computer Science
Semester	VI
Type of Course	SEC
Course Code	24UCAPSEC302
Course Title	**Technical Writing using LATEX**
Course Level	300-399
Course Summary	This course empowers you to create professional and polished technical documents using LaTeX, the industry standard for scientific and academic writing.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	POs
1	LaTeX syntax for formatting elements like text styles (bold, italics), sections, and chapters	Understand	PO1
2	Effectively utilize tables, figures, and equations within LaTeX documents.	Apply	PO1, PO2
3	Explore tools and workflows for efficient LaTeX document creation.	Analyze	PO2
4	Evaluate best practices for clear, concise, and professional technical writing	Evaluate	PO2
5	Create Tables, Graphics and Pictures Lists, Arrays and Bibliography by using LaTeX. Create Slides with Beamers and posters.	Create	PO2, PO8

COURSE CONTENT

Module	Units	Description	Hours	CO
1	Latex Introduction and basics (10 hours)			
	1.1	Introduction to LaTeX. Various integrated development environment (IDE) for LaTeX. Installation of TexStudio. Online Overleaf access.LaTeX content.	5	CO1
	1.2	Structure of LaTeX document. Defining class of the document through \documentclass. Packages and different environments. Creating a Title, chapters and sections and their labeling. Page style, fonts, font sizes, font styles.	5	CO2
2	Creating Document, Tables and formatting (10 hours)			
	2.1	Basic document creation, Preparing basic document, Changing the class – article, report Sectioning, Chapters	5	CO3
	2.2	Labeling Table of Contents, font Effects, coloured text, boxes, theorems, comments & spacing Special characters, line breaking. Columns, multi-columns and minipages. Page numbering, footnotes, headers and footers. Fancy page styles. Short cuts and definitions.	5	CO2
3	Adding references (5 hours)			
	3.1	Inserting pictures and tables. Special environments enumerates, tabular, cases etc. Citation in LaTeX using BibTeX. Creating reference database as .bib file. Bibliography styles.	5	CO4
4	Building ppts and CVs (5 hours)			
	4.1	Presentations in LaTeX. Introduction to beamer class. Themes of beamer presentations. Familiarizing Overleaf and different templates. Journal article templates in Overleaf. Creating CVs in LaTeX	5	CO5

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References

1. The LaTeX Companion, Second Edition by Frank Mittelbach, Michel Goossens, Johannes Braams, David Carlisle, and Sebastian Rahtz.
2. Getting Started with LaTeX by Geoffrey Grimmett.
3. How to Write Mathematics by Edward P. Griffiths and Derek J. Higham.
4. Overleaf Learn LaTeX https://www.overleaf.com/learn/latex/Tutorials: A collection of interactive tutorials covering various LaTeX features.
5. The Comprehensive TeX Archive Network (CTAN) https://ctan.org/?lang=en: A vast repository of LaTeX packages, documentation, and resources.

8. SYLLABUS FOR VALUE ADDITION COURSES

COURSE 01

Discipline/Programme	Computer Science
Semester	III
Type of Course	VAC
Course Code	24UCAPVAC201
Course Title	**IT, Environment and Holistic Living**
Course Level	200-299
Course Summary	This course aims to help students to explore environmental issues and be familiar with the internet. This course is also woven around the methods of strengthening the physical, emotional and intellectual aspects of 'self' based on the principles and practices of Yoga.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Interpret Internet and Environment	Understand	PO 1
2	Evaluate the need for a holistic approach in assessing environmental impact and be able to Incorporate environmental considerations into a cost/benefit analysis.	Analyse	PO 4
3	Discuss about E-waste and Green computing	Understand	PO 5
4	Explain the environmental impact of Information System and be able to draw up realistic plans for reducing this impact	Understand	PO 7
5	Explain the need of yoga for a healthy living	Understand	PO 8

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Internet and Environment(9 hours)			
	1.1	Introduction to Internet and Environment: Internet-Internet as a knowledge repository	2	CO2
	1.2	Academic search techniques, creating cyber presence.	2	CO2
	1.3	Academic websites. Multidisciplinary nature of environmental studies -Definition, scope and importance	3	CO1
	1.4	Need for public awareness.	2	CO5
2	Impact of IT in E-Learning(10 Hours)			
	2.1	Introduction to use of IT in teaching and learning	3	CO2
	2.2	Learning Management System, Moodle, Edmodo, etc	3	CO1
	2.3	Academic services– A note on INFLIBNET, NPTEL, NICNET	4	CO2
3	Various aspects of IT (12 hours)			
	3.1	IT and Society-issues and concerns - digital divide	2	CO4
	3.2	IT & development-the free software movement	2	CO4
	3.3	IT industry: New opportunities and New threats	2	CO3
	3.4	Software piracy, Cyber ethics, Cybercrime, Cyber laws, Cyber threats, Cyber security, Privacy issues,cyber addictions, Information overload	2	CO3

	3.5	Health issues guidelines for proper usage of computers, Internet and mobile phones.	2	CO3
	3.6	Impact of IT on language & culture	2	CO5
4	E-waste and Green Computing(6 hours)			
	4.1	E-waste and Green Computing: E-waste- Problems-Solutions-Impact of E-waste in living beings and environment	2	CO5
	4.2	A study on - Waste Management in India	2	CO5
	4.3	Green computing, definition, meaning, scope. Green computing in India.	2	CO5
5	Yoga for life(8 hours)			
	5.1	Yoga Definition, Objectives of yoga Education, Principles of yogic life	2	CO5
	5.2	Difference between Yoga Asana and physical exercises. Importance of Yoga in daily life.	2	CO5
	5.3	Methods and benefits of Asanas, Pranayama and Concentration,	2	CO4
	5.4	Role of yoga in character building, Role of Yoga practices in developing concentration, will power and discipline, Techniques of stress management.	2	CO5

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References:

1. Alan Evans, Kendall Martin, Mary Anne Poatsy Technology in Action, Pearson
2. Bharucha Erach (2013) Text Book of Environmental Studies for undergraduate Courses. 2nd Edition, University Press.
3. Clark.R.S Marine Pollution, Clanderson Press Oxford
4. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T (2001)Environmental Encyclopedia, Jaico Publication.
5. Dc A.K Environmental Chemistry, Wiley Eastern Ltd.
6. Heywood, V.H & Watson, R.T. (1995) Global Biodiversity Assessment, Cambridge University Press.
7. Dr Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, Third Edition, ORIENT BLACKSWAN PVT. LTD. 3-6-752 Himayatnagar, Hyderabad, 500 029 Telangana

COURSE 02

Discipline/Programme	Computer Science
Semester	III
Type of Course	VAC
Course Code	24UCAPVAC202
Course Title	**White Hat Hacking**
Course Level	200-299
Course Summary	This course delivers the basic idea about ethical hacking
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe the concept of Ethical Hacking	Understand	PO1, PO6,PO8
2	Describe the Information Gathering Methodology and Tools used by Hackers	Understand	PO1, PO6,PO8
3	Summarize various methods of System Hacking	Understand	PO1, PO6,PO8

COURSE CONTENT

Module	Units	Description	Hrs	CO
	Introduction to Ethical Hacking (15Hrs)			

1	1.1	Understanding the importance of security	3	CO1
	1.2	Concept of ethical hacking and essential Terminologies	4	CO1
	1.3	Threat, Attack – Vulnerabilities- Target of Evaluation– Exploit-	4	CO1
	1.4	Phases involved in hacking.	4	CO1
2	Foot printing: The Art of Reconnaissance (15 hours)			
	2.1	Foot printing - Introduction to foot printing	3	CO2
	2.2	Understanding the information gathering methodology of the hackers	6	CO2
	2.3	Tools used for the reconnaissance phase -Port Scanning – Introduction- using port scanning tools- Ping sweeps- Scripting Enumeration.	6	CO2
3	Aspect of remote password guessing (8 hours)			
	3.1	Aspect of remote password guessing- Role of eavesdropping	4	CO3
	3.2	Various methods of password cracking- Keystroke Loggers	4	CO3
4	Sniffing(7 hours)			
	4.1	Understanding Sniffers - Comprehending Active and Passive Sniffing-	4	CO4
	4.2	ARP Spoofing and RedirectionDNS and IP Sniffing- HTTPS Sniffing.	3	CO4

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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References:

1. Patrick Engebretson(2013), “The Basics of Hacking and Penetration Testing” Ethical Hacking and Penetration Testing Made Easy, Syngress Media, Second Revised Edition.

2. RajatKhare(2006), "Network Security and Ethical Hacking", Luniver Press.

3. Ramachandran V(2011), “Wireless Penetration Testing Beginner’s Guide “ 3rd edition Packt Publishing.

4. Thomas Mathew(2003), "Ethical Hacking", OSB publishers

COURSE 03

Discipline/Programme	Computer Applications
Semester	IV
Type of Course	VAC
Course Code	24UCAPVAC203
Course Title	**Green Computing**
Course Level	200-299
Course Summary	The course aims to teach students how to use computers and their resources in an environmentally friendly way.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the concept of green computing and environment sustainability	Understand	PO1, PO8,PO4
2	Assess the benefits of Going Green.	Understand	PO2, PO8,PO4
3	Evaluate the importance and benefits of Paperless work	Analyse	PO7, PO6,PO4

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Concepts of Green IT(17 hours)			
	1.1	Concepts of Green IT: Environmental concerns and Sustainable Development, Carbon Footprint, Environmental impacts of IT,	6	CO 1
	1.2	Holistic Approach to Green IT, Greening IT: Green PC, Notebooks and Servers	6	CO 3
	1.3	Green Data Centers: Green Cloud computing, Green Data Storage, Green Software, Green Networking and Communications,	5	CO 3
2	Concept of Green Device(11 hours)			
	2.1	Concept of Green Devices: Green Device and Hardware, Lifecycle of a Device or Hardware,	6	CO 2
	2.2	Designing, Manufacturing, Packaging, Transportation, Use Reuse, Recycle and Dispose	5	CO 2
3	Green Storage(17 hours)			
	3.1	Going Paperless: Green Storage ,Paperless Office, using internet,	5	CO 3
	3.2	Intranets, EDI Green Data Storage,	6	CO 3
	3.3	Green Drives- SSD, RAID, MAID	6	CO 2

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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References:

1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008

2. Green Computing and Green IT Best Practice, Jason Harris Emereo.

3. Green Data Center: Steps for the Journey, Alvin Galea, Michael Shaefer, Mike Ebbers, Shroff Publishers and Distributors. 2011

4. Harnessing Green IT: Principles and Practices, San Murugesan, IEEE IT Professional.

5. Woody Leonhard, Katherine Murray- Green Home computing for dummies, August 2012/

6. John Lamb- The Greening of IT, Pearson Education, 2009.

COURSE 04

Discipline/Programme	Computer Science
Semester	IV
Type of Course	VAC
Course Code	24UCAPVAC204
Course Title	**Information and Cyber Ethics**
Course Level	200-299
Course Summary	Cyber ethics is a branch of applied ethics that examines moral, legal, and social issues at the intersection of computer/information and communication technologies. This field is sometimes also referred to by phrases such as Internet ethics, computer ethics, and information ethics
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the fundamental concepts of the internet, including its functionality, core protocols (TCP/IP), and IP addressing.	Understand	PO1,PO2,PO8
2	Evaluate the strengths and weaknesses of different information sources on the internet, applying appropriate academic search techniques to locate credible scholarly resources	Evaluate	PO1,PO2
3	Analyze the benefits and challenges of open access initiatives and publishing models in scholarly communication.	Analyse	PO8

4	Demonstrate ethical practices in online behavior, including respecting intellectual property rights and avoiding plagiarism.	Understand	PO6,PO8
5	Assess the impact of IT on various aspects of society, including information overload, cybercrime, and potential health issues	Evaluate	PO6,PO8

COURSE CONTENT

Module	Units	Course description	Hrs	CO
1	Internet (10 hours)			
	1.1	The Internet, TCP/IP	2	CO1
	1.2	IP Addressing, Client Server Communication	2	CO1
	1.3	Intra-net, WWW, Web Browser & Web Server	3	CO1
	1.4	Hyper links, URLs, Electronic mail	3	CO1
2	Role of IT(13 hours)			
	2.1	Internet as a knowledge repository	2	CO2
	2.2	academic search techniques, creating cyber presence	2	CO2
	2.4	Academic websites, open access initiatives	2	CO2
	2.6	opens access publishing models	2	CO2
	2.7	Introduction to use of IT in teaching and learning	1	CO2
	2.8	Educational software	2	CO2, CO3
	2.9	Academic services–INFLIBNET, NPTEL, NICNET, BRNET	2	CO3
3	IPR (7 hours)			
	3.1	Introduction to purchase of technology	2	CO4
	3.2	License, Guarantee, Warranty, Basic concepts of IPR	2	CO4

	3.4	Copyrights and patents, plagiarism	2	CO4
	3.6	IT & development, the free software movement	1	CO4
4	Cyber Space and Cyber Addiction(15 hours)			
	4.1	Cyber space, information overload, cyber ethics	2	CO4
	4.2	cyber addictions, cybercrimes– categories –person, property	2	CO5
	4.3	Government–types-stalking, harassment, threats, security & privacy issues	2	CO5
	4.4	Cyber Addiction, Information Overload, Health Issues	2	CO5
	4.5	e-Waste and Green computing impact of IT on language & culture-localization issues	3	CO5
	4.6	Unicode- IT and regional languages e-Governance in India	2	CO5
	4.7	IT for National Integration, Role of IT	2	CO5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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2. Dinesh Maidasani —Learning Computer Fundamentals, MS Office and Internet & Web Technology‖, Firewall Media, Lakshmi Publications.
3. V Rajaraman - —Introduction to Information Technology‖, Prentice- Hall of India.
4. Barkhs and U. Rama Mohan - HTML Black Book 3. —Cyber Law Crimes‖, Asia Law House, New Edition.
5. Peter Nortons- Introduction to Computers, Sixth Edition, Published by Tata McGraw Hill.

COURSE 05

Discipline/Programme	Computer Science
Semester	VI
Type of Course	VAC
Course Code	24UCAPVAC301
Course Title	**Cyber Forensics and Data Security**
Course Level	300-399
Course Summary	This course aims to impart knowledge o to investigate and analyze cyber security incidents to identify the root cause, gather digital evidence and prevent future attacks
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the basic terminology of Cyber crimes	Understand	PO1, PO4
2	Interpret the concepts of Data Security	Understand	PO2, PO6
3	Analyse the performance of cyber security systems	Analyse	PO2, PO6
4	Evaluate various data security strategies	Evaluate	PO1, PO2

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Foundation of Cyber Forensics(12 Hours)			
	1.1	Introduction to Cyber Forensics	4	CO1
	1.2	Legal Framework and Ethics in Cyber Forensics	4	CO1
	1.3	Forensic Science Principles and Digital Evidence	4	CO1
2	Data Security Fundamentals(8 Hours)			
	2.1	Data Security Fundamentals: Understanding Data Security, Data encryption and protection techniques, Implementing Data Security Policies	4	CO2
	2.2	Digital Forensics Tools and Techniques: Overview of Forensic Software and Hardware tools, Data Acquisition and Duplication Methods, Network Forensics and Analysis	4	CO2
3	Cybercrime and Investigation Techniques(10 Hours)			
	3.1	Cyber crime and Investigation Techniques: Types of Cybercrimes, Investigative Methodologies, Reporting and Documentation of Cyber Crimes	3	CO2
	3.2	Advanced Data Security Strategies: Risk Management and Mitigation	3	CO3
	3.3	Advanced Cryptography, Secure System Design and Implementation, Practical Application and Case Studies	4	CO3, CO4

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References:

1. Cyber Forensics by Dejey Murugan
2. Computer Forensics: cybercriminals, Laws and Evidence, by Marie Helen Maras.
3. Guide to Computer Forensics and Investigations by Bill Nelson, Amelia Philips and Christopher Steuart

COURSE 06

Discipline/Programme	Computer Science
Semester	VI
Type of Course	VAC
Course Code	24UCAPVAC302
Course Title	**Cyber Security and Ethical Hacking**
Course Level	300-399
Course Summary	This course is intended to inculcate the significance of ethical hacking and cyber security apart from creating awareness about various types of security threats that may affect data integrity.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe the cybersecurity principles and ethical hacking techniques	Understand	PO1, PO6
2	Identify and mitigate potential cyber threats, reducing the risk of data breaches	Analyse	PO1, PO6
3	Enhance the practical proficiency of learned concepts	Apply	PO1, PO2, PO6

COURSE CONTENT

Module	Units	Description	Hours	CO
1	Introduction to CyberSecurity(12 Hours)			
	1.1	Introduction to cybersecurity: Understanding the Cyber Threat Landscape, Importance of cybersecurity in Today's world.	4	CO1
	1.2	Fundamentals of Ethical Hacking, Legal and Ethical considerations	4	CO1
	1.3	Network Security: Securing Network Infrastructure	4	CO1
2	Network Security and Best Practices(7 Hours)			
	2.1	Wireless network Security	4	CO2
	2.2	Web Application Security: Common Web application vulnerabilities, Best Practices in Web Application Security	3	CO2
3	Incident Response and Management & Applications of Ethical Hacking(11 Hours)			
	3.1	Incident Response and Management: Identifying and responding to cyber incidents, Developing an incident response plan	4	CO3
	3.2	Hands-on Labs and Practical Exercises: Application of Ethical Hacking techniques	3	CO3
	3.3	Real world Scenarios and Case studies	4	CO3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning,

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A. Continuous Comprehensive Assessment (CCA)
Theory:
Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. Any other method as may be required for specific course by the course faculty.
Practical:
Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.</td></tr>
<tr><td>B. End Semester Examination (ESE)
Theory:
Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.
Practical:
Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.</td></tr>
</table>

References:

1. Fadia Ankit. An unofficial guide to Ethical Hacking.
2. Hacking: The Art of Exploitation by Jon Erickson.
3. The Basics of Hacking and Penetration Testing by Patrick Engebretson.
4. The Web Application Hacker’s Handbook by Dafydd Stuttard.

COURSE 07

Discipline/Programme	Computer Science
Semester	VI
Type of Course	VAC
Course Code	24UCAPVAC303
Course Title	**Health and Wellness**
Course Level	300-399
Course Summary	This course imparts the knowledge of personal health concepts with emphasis on the body system, emotional health, drug use and abuse, disease, nutrition and community health.
Lecture/Tutorial/Practical Hours	45/0/0
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Importance of a healthy lifestyle	Understand	PO4,PO6,PO8
2	Improve the physical and mental health	Apply	PO4,PO6,PO8
3	Interpret the various lifestyle related diseases	Understand	PO4,PO8
4	Explain the stress management.	Understand	PO4,PO8,PO6

COURSE CONTENT

Module	Units	Description	Hrs	CO
1	Introduction to Health and Wellness (11 hours)			
	1.1	Define and differentiate health and wellness, Importance of health and wellness Education.	3	CO1
	1.2	Local, demographic, societal issues and factors affecting health and wellness Diet and Nutrition for health and Wellness	3	CO1
	1.3	Essential components of balance diet for health living with specific reference to the role of carbohydrates, proteins, fats, vitamins and minerals	3	CO1
	1.4	Processed foods and unhealthy eating habits	2	CO1
2	Deficiencies and Diseases (14 hours)			
	2.1	Malnutrition, undernutrition and overnutrition. Body systems and common diseases. Sedentary lifestyle and its risk of disease.	2	CO2
	2.2	Stress, anxiety and depression. Factors affecting mental health. Identification of suicidal tendencies	6	CO2
	2.3	Healthy food for prevention and progression of cancer.	6	CO2
3	Diseases and Substance Abuse(13 hours)			
	3.1	Hypertension, Cardiovascular, and metabolic diseases such as Obesity, Diabetes, Polycystic Ovarian Syndrome.	5	CO3
	3.2	Substance abuse, Types of Physical Fitness and its Health benefits.	5	CO3
	3.3	Postural deformities and corrective measures. Spirituality and mental health.	3	CO3
	Management of Health and Wellness(7 hours)			

4	4.1	Role of Yoga, asanas and meditation in maintaining health and wellness.	4	CO4
	4.2	Role of sleep in maintenance of physical and mental health	3	CO4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty.* **Practical:** *Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.*
	B. End Semester Examination (ESE) **Theory:** *Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.* **Practical:** *Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.*

References:

1. Physical Activity and Health by Claude Bouchard,Steven N.Blair, Williams L. Haskell
2. Mental Health Workbook by Emily attached & Marizia Fernandez, 2021
3. Mental Health Workbook for Women: Exercise to Transform negative thoughts and Improve Well-Being by Nashay Loric, 2022
4. Lifestyle Diseases: Lifestyle Disease management by C. Nyambichu & Jeff Lumiri, 2018