BACHELOR OF COMPUTER SCIENCE

2024

BCA (Bachelor of Computer Applications) Honours - 2024

AMRITA VISHWA VIDYAPEETHAM

REGULATIONS FOR THE BCA HONOURS PROGRAMME

UNDER SCHOOL OF COMPUTING

(Effective from 2024 admissions)

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GENERAL

1. Candidates who have passed for admission to the UG degree programme. However, the eligibility criterion is subject to modification as per the directives of competent authorities.

2. The procedure for admission will be decided from time to time by the University in accordance with the guidelines from competent authorities. the final examination under the 10 +2 system or its equivalent, with a minimum of 50% of marks in aggregate, are eligible to apply

3. The duration of the Programme will normally be eight semesters, spread over four academic years.

4. The award of the respective UG Honours degree will be recommended by the Academic Council and approved by the Board of Management in accordance with the regulations of the University.

    Students who choose to exit after 3 years shall be awarded BCA Degree in after the successful completion of the required minimum Courses with 141 credits.

    A 4-year BCA Honours shall be awarded to those who complete the programme with a specific number of Courses with 178 credits.

5. Notwithstanding anything stated above, the Amrita Vishwa Vidyapeetham reserves the right to modify any of the ordinances, as deemed fit, from time to time.

R.1 Admissions

R.1.1 The admission to the programme will be as per the ordinances and regulations of the University.

R.1.2 The intake to each school will be decided by the University from time to time.

R.1.3 Transfer of students from one campus to another is generally not permitted. However, based on the availability of vacancies in the discipline and the academic merit of the student, special cases may be allowed in the beginning of the third semester, on the mutual consent of the Heads of both the Departments and Schools and with the approval of the University. The decision of the University will be final in this matter.

R.2 Language of Instruction

The language of instruction will ordinarily be English, for all courses. For *Cultural Education*, instruction may be given partly in Indian languages. In the case of languages, instruction may be in English or the language concerned.

R.3 Structure of the Programme

R.3.1 The Programme will be structured on a credit-based system and continuous evaluation, following a semester pattern.

R.3 2 The programme consists of the following:

   (a) Core courses in the primary area of the programme, including seminars, projects, etc.

   (b) Humanities and General Studies (like *Environmental Sciences, Open Electives, Languages, Amrita Value Programmes* and *Cultural Education*, etc.

   (c) Electives (Regular, Data Science and Cyber Security Stream)

   (d) Professional Electives (Regular, Data Science and Cyber Security Stream)

   Additionally, soft skill training and some social interaction/social work programmes, like Live-in Labs may also be

offered.

R.3.3 The curriculum of the UG degree programme will have credits, apportioned as below in the following knowledge segments:

Core courses

Electives

Humanities and General Studies

R.3.4 Credits are assigned to the courses based on the following general pattern -

One credit for each lecture period per week

One credit for each tutorial period per week

One credit for each laboratory course/practical of two/three periods per week

R.3.5 Each UG degree programme shall have a prescribed curriculum and syllabi, which will be periodically updated according to the requirements and approved by the Academic Council.

R.3.6 All the Schools will be governed by the same curricula and syllabi, for the respective programmes.

R.3.7 Certain courses are identified as Core courses and a few others as electives.

There is a mandatory registration and credit earnings requirement for core courses. While it is mandatory to register for the elective courses, failure to earn credit in them does not necessarily require repeating the courses. Often another elective course may be permitted as a replacement course, through Regular registration, with the concurrence of the Class Advisor and the Head of the Department.

R.3.8 Students are allowed to take online courses through Government portals such as NPTEL and SWAYAM

1. Amrita's grade, equivalent to the score secured in online courses to be decided by the class committee, and the same is to be awarded to the students.

2. The Class committee should authorize the courses before registration.

3. Students who have a Cumulative Grade Point Average (CGPA) of 6.5 or higher are eligible to enroll in NPTEL/SWAYAM courses for credits. However, the number of credits should not exceed eight.

4. The Course registration requisite of a maximum of 28 credits per semester is to be maintained while registering for online courses.

R.3.9 Programme Educational Objectives (PEOs)

PEO 1: Graduates will strive on a global platform to pursue their career in Computer Applications.

PEO 2: Graduates will contribute as entrepreneurs in interdisciplinary areas.

PEO 3: Graduates will demonstrate high regard for professionalism, integrity, and respect values in diverse cultures, and have a concern for society and the environment.

R.3.10 Programme Outcomes (POs)

PO 1. **Computational Knowledge:** Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.

PO 2. **Problem Analysis:** Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

PO 3. **Design /Development of Solutions:** Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO 4. **Conduct Investigations of Complex Computing Problems**: Use research-based knowledge and research methods, including the design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern Tool Usage:** Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO 6. **Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

PO 7. **Life-long Learning:** Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.

PO 8. **Project management and finance:** Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to 16 manage projects and in multidisciplinary environments.

PO 9. **Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

PO 10. **Societal and Environmental Concern:** Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

PO 11. **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO 12. **Innovation and Entrepreneurship:** Identify a timely opportunity and use innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

R.3.11 **Programme Specific Outcomes (PSOs)**

PSO 1. Examine their skills in methodical planning, creating, testing, and implementing intricate computing applications within the realms of Social Media and Analytics, Web Application Development, and Data Interpretation.

PSO2. The capability to effectively develop applications that can acquire, manage, and analyze large volume of data.

PSO 3.Provide comprehensive knowledge and continuous learning that fosters creativity across multiple disciplines, encourages innovation, and supports research endeavors to address global concerns.

R.4 Tuition Fees

At the beginning of each academic semester, students shall pay all the fees prescribed. A student who drops out of the programme or whose registration is cancelled due to any reason, cannot claim refund of any fees paid.

R.5. Mentor and Class Advisor

R.5.1 To (i) guide the students in planning their courses of study, (ii) advise them on academic programmes and (iii) monitor their progress, the departments will assign a batch (class) of a certain number of students to a faculty member, who will be designated as their mentor.

R.5.2 One among the mentors, shall be designated as the Class Advisor, who shall coordinate the functions of the Class mentors.

R.6. Course Committees

R.6.1. Course committees are constituted for running courses which are common for more than one discipline. Course committees will be set up in each School for each group of similar courses as decided by Head of the School.

R.6.2. Each course committee will consist of the following members:

(i) The chairperson of the course committee, nominated by the Head of the School.

(ii) All teachers involved in teaching the courses, shall be included in the course committee

(iii) Two student members from each discipline nominated into the committee by the chairpersons of departments with equal representation to boys and girls, to the extent possible.

(iv) Chairpersons of the departments and the School Head may attend meetings of the course committees.

R.6.3. The Course Committees shall meet at least thrice in a semester. The Course committees shall meet at the beginning of the semester to finalise the course plans for the academic programme. They shall meet at the end of the semester, without the student representatives, to finalise the results of the respective courses. The results shall be submitted to the Head of the School, who shall approve and forward the same, to the Examination section.

R.6.4. The Course committees shall be reconstituted at the beginning of every semester.

R.7 Class Committees

R.7.1 Every class of a Degree programme in each School will have a Class Committee constituted by the Head of the School, based on recommendation of the Chairperson of the department.

R.7.2. The Constitution of the Class Committee will be as follows:

a) The Chairperson of the class committee, nominated by Head of the School,

b) All the teachers handling courses for the class,

c) Two student representatives nominated by the Chairperson of the department, from each class with equal representation of boys and girls, to the extent possible.

d) The Chairperson of the department and School Head may attend the committee meetings.

R.7.3. The Class Committee shall meet at least thrice in a semester. The Class committee shall meet at the beginning of the semester to finalise the academic programme. At the end of the semester the committee (without student representatives) will meet, to finalise the results. The results shall be submitted to the Head of the School, who shall approve and forward the same, to the Examination section

R.7.4. The Class committees shall be reconstituted at the beginning of every semester.

R.8 Registration and Enrolment

R.8.1 Every student shall register for the courses which he/she wishes to undergo during a semester.

R.8.2 Except for the first semester, pre-registration for a semester will be done during a specified week before the end-semester examination of the previous semester. The consent of the Class Advisor is mandatory before registering for every course.

R.8.3 From the second semester onwards, all students have to enroll on a specified day at the beginning of a semester. A student will be eligible to enroll only if he/she has cleared all the dues to the Institution, hostel, library, etc., at the time of enrolment and if he/she is not debarred from enrolment, as part of any disciplinary action of the Institution.

R.8.4 Late enrolment will be permitted on payment of a prescribed late fee, up to a specified date, to be notified well in advance.

R.8.5 A student can register for a maximum of 28 credits, in a semester, including all the remedial provisions.

R.8.6 **Pre-requisites:** A student is not permitted to register for a course unless he/she has already attended the pre-requisite course, wherever specified. A student will not be deemed to have attended the pre-requisite, if he/she gets an 'FA' grade in such a course.

R.9 Dropping /Substituting Courses

R.9.1 If a student finds his/her load heavy in any semester, or for any other valid reasons, he/she may drop courses, within **first ten working days** of the commencement of the semester, with the written approval of his/her Class Advisor and Chairperson of the Department.

Withdrawal from one or more enrolled courses after the specified date, will entail academic penalties in the form of a 'Failed due to insufficient attendance' 'FA' grade appearing in the grade sheet.

R.9.2 A student can substitute a course registered earlier, by another for valid reasons, within **first ten working days** of the commencement of the semester, with the consent of the Class Advisor and Chairperson of the Department.

R.10 Maximum Duration of the Programme

R.10.1 A student is expected to complete the UG programme in eight semesters. However, a student may complete the programme at a slow pace within twelve semesters, with the prior permission of his/her Class Advisor and Chairperson of the Department and Head of the School. A student can exit from the programme after completing three years with an award of BCA degree.

R.10.2 A student may be permitted by the concerned Head of the School to withdraw from the programme for a semester or a longer period for reasons of ill health or on other valid grounds. However, the programme should be completed within a total span of twelve semesters.

R.10.3 In the event of any student requiring more than twelve semesters to complete the programme, the extension can be considered on the merits of the case, by the Vice-Chancellor and ratified by the Academic Council.

R.11 Attendance

R.11.1 Attendance of the students will be marked by the concerned teacher during every hour of the course.

R.11.2 Students who have been selected to be trained for International competitions or have secured distinction in the previous year examinations and are working on directed research under a faculty member, and approved by the Chairperson of the Department, shall be given a waiver of up to 25% attendance.

R.11.3 Leave shall be availed by students only under unavoidable circumstances. It is mandatory that students shall apply in the prescribed form before proceeding on leave. Leave letter recommended by the Class Advisor shall be submitted to the Chairperson of the department who will consider grant of the leave. Unauthorized absence will be treated as breach of discipline.

Request for leave for more than three consecutive days on medical grounds, must be supported by a proper medical certificate. In non-medical cases, requests for leave for more than three consecutive days must be countersigned by the parent/guardian or the Warden, whichever is applicable.

Leave granted will not be counted as physical presence.

R.11.4 Students going on official duty, such as representing the college/University for sports and cultural activities, or presenting papers in seminars, conferences, etc., will be eligible for 'duty leave' on the recommendation of the Class Advisor and approval by the Chairperson of the Department. **Students should get this leave sanctioned before proceeding on 'duty leave'. They will be granted attendance for the periods they missed on account of the duty leave upon production of the relevant participation certificate after attending the duty.**

All kinds of leave, authorized by the Chairperson of the Department, shall not exceed 25% of the total hours in the course.

R.11.5 Finalisation of attendance for every course shall be done three working days before the last instruction day of the semester. Any student failing to secure a minimum of 75% attendance in a course, will not be eligible to appear for the end-semester examination in that course.

R.11.6 In case a student who is not permitted to attend the end-semester examination in any course due to shortage of attendance, will be awarded 'FA' grade in that course, indicating "failed due to insufficient attendance" and mentioned in the grade sheet.

Students awarded 'FA' grade in a course, shall re-register for the course, when offered next or as a run-time re-do course.

R.12 Assessment Procedure

R.12.1 The academic performance of each student in each course will be assessed on the basis of Internal Assessment (including Continuous Assessment) and an end-semester examination.

Normally, the teachers offering the course will evaluate the; performance of the students at regular intervals and in the end-semester examination.

In theory courses (that are taught primarily in the lecture mode), the weightage for the Internal Assessment and End-semester examination will be 50:50. The Internal assessment in theory courses shall consist of one mid-term examination, weekly quizzes, assignments, tutorials, viva-voce etc. The weightage for these components, for theory-based courses shall be 25 marks for the Continuous assessment, comprising of Quizzes, assignments, tutorials, viva-voce, etc. and 25 marks for the mid-term examination.

At the end of the semester, there will be an end-semester examination of three hours duration, with a weightage of 50 marks, in each lecture-based course.

R.12.2 In the case of laboratory courses and practicals, the relative weight for Internal assessment and End-semester examination will be 70:30. The weight for the components of Internal assessment will be decided by the course committee/class committee at the beginning of the course.

Evaluation pattern for the course having both Theory and Lab. components:

Courses having only one hour per week for lecture/tutorial, be treated as a Lab course, for evaluation purposes; and the evaluation pattern will be 70 marks for continuous assessment of lab. work and 30 marks for the end-semester lab Examination.

Courses having two hours or three hours per week for theory and/or tutorials, be given a weightage of 60 marks and 40 marks for the Theory and Lab components respectively; The Lab. component evaluation will be based on continuous evaluation, without any end-semester practical evaluation. 10 marks will be for continuous

assessment of the theory portion, 20 marks for the mid-term examination, 30 marks for the theory end-semester examination, and 40 marks for continuous assessment of lab work.

R.12.3 It is mandatory that the students shall appear for the end-semester examinations in all theory and practical courses, for completion of the requirements of the course. Those who do not appear in the end-semester examinations will be awarded an 'F' grade, subject to meeting the attendance requirement.

At the end of a semester, examinations shall be held for all the subjects that were taught during that semester and those subjects of the previous semesters for which the students shall apply for supplementary examination, with a prescribed fee.

R.12.4 PROJECT WORK AND INTERNSHIP: The continuous assessment of project work will be carried out as decided by the course committee. At the completion of the project work, the student will submit a bound volume of the project report in the prescribed format. The project work will be evaluated by a team of duly appointed examiners.

The final evaluation will be based on the content of the report, presentation by student and a viva-voce examination on the project. There will be 60% weightage for continuous assessment and the remaining 40% for final evaluation.

If the project work is not satisfactory, he/she will be asked to continue the project work and appear for assessment later.

Students have to undergo Internship at reputed organisations or National / International Institutions, with the prior approval of the concerned Departmental Chairperson and the Head of the School. Internship of 3 to 4 Weeks may be taken up by the student in the summer break. Internship can be done in an industry OR Start-up OR at research laboratories OR centres of excellence in own institute or other institutions outside, working preferably in the field of latest technologies.

The continuous assessment of internship will be carried out as decided by the course committee. At the completion of the internship, the student will submit a bound volume of the report in the prescribed format. The work will be evaluated by a team of duly appointed examiners.

The final evaluation will be based on the content of the report, presentation by student and a viva-voce examination on the project. There will be 40% weight for continuous assessment and the remaining 60% for final evaluation.

Course Category	L-T-P	Internal: External	Internal (%)		External (%)	Total Theory Weightage (%)	Total Lab Weightage (%)
			Mid-term	CE			
Theory without a lab component	4-0-0/3-1-0/3-0-0 / 2-1-0 /2-0-0/ 1-1-0/ 1-0-0	50:50	25	25	50	100	-
Theory with a lab component	2-0-1/ 3-0-1	70:30	20	50	30	60	40*
Lab courses	0-1-1/1-0-1/ 0-0-1	70:30	70		30	-	100
Mini/Major Project		60:40	60		40	-	-

Internship		40:60	40	60	-	-
				*No end-semester practical exam.		

R.13 GRACE MARKS

R.13.1 All students who publish a paper in Scopus-indexed Journal/Conference will be awarded an additional mark of 5-10 for each publication, subject to a maximum of two publications.

The additional marks shall be awarded in the semester in which the paper is published or accepted for publication, if applied for, before the publication of results of the concerned semester.

R.13.2 **Co-curricular Activities**

The students during their period of study in the University are encouraged to indulge in sports, arts, Social/Community service, and Seva activities. Bonus marks (5 to 10 marks) shall be awarded for representing AMRITA University in Sports, Cultural, and Seva activities. The procedure for awarding these marks will be published by the University from time to time.

R.14 REMEDIAL PROVISIONS

R.14.1 **Supplementary Examinations:**

Students who failed in a non-semester course (i.e. courses not registered by the student during the current semester), shall apply for by appearing in the respective examination paying a prescribed fee, and take the examination.

A student who has secured an 'F' grade in a course may take the supplementary examination for a maximum of three additional attempts (excluding the regular end-semester examinations) carrying the previous Internal marks earned by them. Students failing to pass the course after three additional attempts shall henceforth appear for the supplementary examination for the entire 100 marks and the Internal assessment marks earned by them in the regular registration, shall not be considered.

If a student wishes to improve his/her internal marks, he/she can do so, by re-registering for the course by choosing any of the appropriate remedial options. In this case, the internal marks obtained by the student will be valid for the end semester of the re-registration and three more additional attempts.

R.14.2 **Other options:**

Certain courses may be offered as run-time-redo or as contact courses, as and when necessary to enable students who have dropped courses or failed in some courses, to register and endeavor to complete them.

a) Re-registration: Students who have failed a course and opt to re-do the course may do so by re-registering for the course, along with a junior batch of students,

b) Run-time re-do: Certain courses may be offered specially for the benefit of failed students during the semester, on a regular pattern.

The above two modes enable possible improvement of the Internal assessment marks.

c) Contact courses: Final-semester students and term-out students (students who have completed three years) may register for contact mode, to clear the failed courses, if any, subject to the approval of the Head of the School.

A maximum of only two courses can be taken under contact mode, in the entire programme of study.

R.14.3 Supplementary examinations will be evaluated against the most recent grade rule (whenever the course was offered recently in the regular semester).

R.15 Grading

R.15.1 Based on the performance in each course, a student is awarded at the end of the semester, a letter grade in each of the courses registered. Letter grades will be awarded by the Class Committee in its final sitting, without the student representatives.

The letter grades, the corresponding grade points and the ratings are as follows:

Letter Grade	Grade Points	Ratings
O	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0. 00	Fail
FA	0. 00	Failed due to insufficient attendance
I	0. 00	Incomplete (awarded only for Lab. courses/ Project /Seminar)
W		Withheld

R.15.2 'FA' grade once awarded stays in the record of the student and is replaced with the appropriate grade when he/she completes the course successfully later.

Students who have secured an 'FA' in a course must re-register for the course or register for the course, if offered, under run-time re-do mode.

R.15.3 A student who has been awarded an 'I' Grade in a Lab course, due to reasons for not completing the Lab, shall take up additional Lab whenever offered and earn a pass grade, which will be reflected in the next semester's grade sheet.
The 'I' grade, awarded in a Project/Seminar course, will be subsequently changed into an appropriate grade when the student completes the requirement during the subsequent semester. If he/she does not complete it in the next semester, it will be converted to 'F' grade.

R.15.4 A student is considered to have successfully completed the course and earned the credit, if he/she scores a letter grade 'P' or better in that course.

R.16 Declaration of Result

After finalization of the grades by the Class Committee and subsequent approval of the Head of the School, the result will be announced by the Controller of Examinations.

R.17 Revaluation of Answer Papers

On publication of the results, an aggrieved student can request for revaluation of answers scripts of the end-semester examination, within five working days of publication of the results, along with the prescribed revaluation fees. The request has to be made to the Examination Section, through the Head of the School.

If the revaluation leads to a better grade, the revised grade will be awarded to the student and in such cases, the revaluation fee will be refunded in full.

Revaluation is permitted only for lecture-based courses.

R.18 Course completion:

A student is said to have completed a course and earned the corresponding credits if he/she has:

- registered for the course :

- put in 75% or more attendance in the course

- appeared for the end-semester examinations

- obtained a passing grade 'P' or better in the course

- no pending disciplinary proceedings against him/her

R.19 Grade Sheet

The Grade Sheet issued to the student at the end of a semester will contain the following information:

- Name, Roll No. Grade Sheet No., Semester, Branch, Month and year of the Examination,

- Course Code, Course Title, Credits, Grade obtained and Grade points earned for the courses registered,

- Credits registered and earned during the semester

- Cumulative credits earned and Grade Points

- SGPA

- CGPA

R.20 Semester Grade Point Average (SGPA)

On completion of a semester, each student is assigned Semester Grade Point Average (SGPA) which is computed as below for all courses registered by the student during that semester.

$$\text{Semester Grade Point Average} = \sum (C_i \times Gp_i) / \sum C_i$$

where C_i is the credit for i^{th} course in that semester and Gp_i is the grade point for that course.

The summation is over all the courses registered by the student during the semester, including the failed courses. The SGPA is rounded off to two decimals.

R.21 Cumulative Grade Point Average (CGPA)

The overall performance of a student at any stage of the Degree programme is evaluated by the Cumulative Grade Point

Average (CGPA) up to that point in time.

$$\text{Cumulative Grade Point Average} = \sum (C_i \times Gp_i) / \sum C_i$$

where C_i is the credit for i^{th} course in any semester and Gp_i is the grade point for that course.

The summation is over all the courses registered by the student during all the semesters up to that point of time, including the failed courses. The CGPA is also rounded off to two decimals.

R.22 Ranking

The ranking of the students in a batch at any intermediate or final stage is based on CGPA. Only those students who have passed all courses up to that stage in the first attempt are considered for ranking.

Students are eligible for final ranking, only if they complete the programme within the normal duration, i.e., within three years from joining the programme.

R.23 Classification of successful candidates:

R.23.1 A student shall be considered to have completed the programme, if he/she has:

    i) registered and completed all the core courses, electives, and projects as mentioned in the curriculum;

    ii) earned the required minimum number of credits as specified in the curriculum corresponding to the programme, within the stipulated time;

R.23.2 Candidates who have completed the programme, within six semesters of entering the programme, shall be classified as follows:

Candidates securing a CGPA of 8.00 and above – FIRST CLASS WITH DISTINCTION

Candidates securing a CGPA between 6.50 and 7.99 – FIRST CLASS and the same be mentioned in the Degree certificate;

Suppose the programme is completed after six semesters of study. In that case, the candidates securing even a CGPA of 8.00 and above, shall be classified as having completed the programme, only with FIRST CLASS.

R.24 Transcript

The Controller of Examinations will also issue, on request and payment of a prescribed fee, a detailed transcript with his signature or facsimile to every student after completion of the programme. It shall contain all the information that is contained in the grade sheets. Additionally, it shall also include the month and year of passing each course. The transcript card shall contain only the final grades secured, but will not indicate the earlier failures, if any. The detailed transcript, will contain the CGPA and the class, if any obtained.

R.25 Discipline

Every student is required and expected to observe strict discipline and decorous behavior both inside and outside the campus. He/she should not indulge in any activity that may tarnish the fair name and prestige of Amrita Vishwa Vidyapeetham. Any act of indiscipline or misbehaviour including unfair practice in the examinations will be dealt with by the Disciplinary Action Committee of the Institution, constituted by the Head of the School concerned. The committee will enquire into the charges and make recommendations to the Head of the School concerned. Based on the findings of the committee, Head of the School will take appropriate disciplinary action. Serious act of indiscipline on the part of the students may even attract penalty up to the extent of expulsion from the University.

R.26 Redressal of grievances

Students have the right to seek redress of grievances. For this, they have to appeal in writing to the Head of the School concerned, who will take the necessary steps in the matter.

R.27 Award of the Degree

A student will be declared eligible for the award of the respective Degree if he/she has:

a) completed the programme successfully as described in R.23.1 and

b) no outstanding dues against him/her.

c) Specialization – any student who completes the program with minimum requirement (5 and above in the respective stream out of 10 electives) in the concerned stream will be awarded the degree with specialization. No specialization will be given to exit students after 3 years.

The UG Degree, indicating the discipline and specialization (if applicable), will be awarded by the Board of Management of Amrita Vishwa Vidyapeetham on the recommendation of the Academic Council.

R.28 Interpretation Clause

Related to any of the academic matters, whenever there arises any doubt or dispute on the interpretation of regulations or rules, the decision of the Academic Council will be final as well as binding on all concerned.

R.29 Amendment to Regulations

Notwithstanding anything stated above, the Amrita Vishwa Vidyapeetham reserves the right to modify any of the regulations, as deemed fit, from time to time.

CURRICULUM AND SYLLABUS
2024

4 YEAR BCA HONOURS

EXIT OPTIONS AND CREDIT REQUIREMENTS

The proposed Curriculum Framework for the Four-year BCA Honours Programme as per the UGC Guidelines under NEP 2020 intends to provide opportunities that can enable the students to acquire competence in using digital technologies, computational methods, and other skills essential to participate in the knowledge economy. Guidelines for the prescribed Discipline Specific core courses as well as the optional Discipline specific elective courses, Skill enhancement courses, Ability enhancement courses, Value added courses, Generic electives, Internship and projects are all specified in the given curriculum.

Exit With	Credit Requirement
BCA at successful completion of Third year (six semesters) of the four-year undergraduate Degree Programme.	141
BCA with HONOURS at the successful completion of Four Year (Eight semesters) of the Four-year undergraduate Degree Programme.	178

BCA HONOURS CREDIT DISTRIBUTION

Code	Category	Number of Courses	Credits
DSC	Discipline Specific Core	31	102
DSE	Discipline Specific Elective	13	37
AEC	Ability Enhancement Course	4	8
VAC	Value Addition Course	7	12
SEC	Skill Enhancement Course	5	10
GE	Generic Elective	3	9
	TOTAL		**178**

SEMESTER I

Course Code	Title	Category	L T P	Credit
22ADM101	Foundations of Indian Heritage	VAC	2 0 1	2
24ENG101	English I	AEC	2 0 0	2
	Language I	AEC	2 0 0	2
22AVP103	Mastery Over Mind	VAC	1 0 2	2
24ENV200	Environmental Science and Sustainability	VAC	3 1 0	4
	Mathematics for Computing I	DSC	3 1 0	4
24CSA101	Computer Fundamentals and Digital Electronics	DSC	3 0 1	4
24CSA102	Problem Solving and Computer Programming using C	DSC	3 0 0	3
24CSA181	Problem Solving and Computer Programming using C Lab	DSC	0 0 1	1
24CSA182	Introduction to Linux - LAB	SEC	0 1 1	2
	TOTAL			**26**

SEMESTER II

Course Code	Title	Category	L T P	Credit
22ADM111	Glimpses of Glorious India	VAC	2 0 1	2
24ENG111	English II	AEC	1 0 2	2
	Language II	AEC	2 0 0	2
24CSA111	Database Management System	DSC	3 0 0	3
	Mathematics for Computing II	DSC	3 1 0	4
24CSA112	Object Oriented Programming Using JAVA	DSC	3 1 0	4
24CSA183	Database Management System LAB	DSC	0 0 1	1
24CSA184	Object Oriented Programming Using JAVA LAB	DSC	0 0 1	1
24CSA185	User Interface Design	SEC	0 1 1	2
24CUL100	I AM TECH	VAC		P/F
	TOTAL			**21**

SEMESTER III

Course Code	Title	Category	L T P	Credit
	Amrita Value Programme 1	VAC	1 0 0	1
23LSK201	Life Skills 1	SEC	1 0 2	2
	Mathematics for Computing III	DSC	3 1 0	4
24CSA201	Data Structures	DSC	3 1 0	4
24CSA202	Operating Systems	DSC	3 0 0	3
24CSA203	Computer Organization and Architecture	DSC	3 0 0	3
24CSA298*	Open Elective I / MOOC	GE	3 0 0	3
24CSA281	Data Structures LAB	DSC	0 0 1	1
24CSA204	Web Technologies	DSC	2 0 1	3
	TOTAL			**24**

SEMESTER IV

Course Code	Title	Category	L T P	Credit
	Amrita Values Programme II	VAC	1 0 0	1
23LSK211	Life Skills II	SEC	1 0 2	2
	Open Elective II	GE	3 0 0	3
24CSA211	Computer Networks	DSC	3 0 1	4
24CSA212	Full Stack Frameworks	DSC	3 1 0	4
24CSA213	Data Mining	DSC	2 1 0	3
24CSA214	Design and Analysis of Algorithm	DSC	3 1 0	4
24CSA282	Full Stack Framework LAB	DSC	0 0 1	1
24CSA283	Introduction to Python Lab	DSC	0 0 1	1
	TOTAL			**23**

SEMESTER V

Course Code	Title	Category	L T P	Credit
23LSK301	Life Skills III	SEC	**1 0 2**	2
24CSA301	Machine Learning	DSC	3 0 0	3
24CSA380	Machine Learning Lab	DSC	0 0 1	1
24CSA302	Python Frameworks	DSC	3 0 1	4
24CSA390*	Live in Labs*/Open Elective III	GE	3 0 0	3
24CSA303	Mobile Application Development	DSC	2 0 1	3
	Lab Elective 1	DSE	0 0 1	1
	Elective - 1	DSE	3 0 0	3
24CSA395**/24CSA396***	Internship**/Minor Project-I***	DSC		4
	TOTAL			**24**

SEMESTER VI

Course Code	Title	Category	L T P	Credit
24CSA311	Automata Theory and Compiler Design	DSC	3 1 0	4
24CSA312	Software Engineering	DSC	3 0 1	4
	Elective 2	DSE	3 0 0	3
	Professional Elective 1	DSE	3 0 1	4
24CSA397*	Lab Elective 2/MOOC*	DSE	0 0 1	1
24CSA313	Cryptography and Cyber Security	DSC	3 0 0	3
24CSA399*/24CSA398**	Minor Project-II*/Internship**	DSC		4
	TOTAL			**23**

SEMESTER VII

Course Code	Title	Category	L T P	Credit
	Professional Elective 2	DSE	3 0 1	4
	Professional Elective 3	DSE	3 0 1	4
	Lab Elective 3	DSE	0 0 1	1
	Elective 3	DSE	3 0 0	3
	Elective 4	DSE	3 0 0	3
	Elective 5	DSE	3 0 0	3
	TOTAL			**18**

SEMESTER VIII

Course Code	Title	Category	L T P	Credit
	Professional Elective 4	DSE	3 0 1	4
	Elective 6	DSE	3 0 0	3
24CSA499	Project	DSC		12
	TOTAL			**19**

LANGUAGES

Paper I			
Course Code	Title	L T P	Credit
24HIN101	Hindi I	2 0 0	2
24KAN101	Kannada I	2 0 0	2
24MAL101	Malayalam I	2 0 0	2
24SAN101	Sanskrit I	2 0 0	2
24TAM101	Tamil I	2 0 0	2
24ENG100	Additional English I	2 0 0	2

Paper II			
Course Code	Title	L T P	Credit
24HIN111	Hindi II	2 0 0	2
24KAN111	Kannada II	2 0 0	2
24MAL111	Malayalam II	2 0 0	2
24SAN111	Sanskrit II	2 0 0	2
24TAM111	Tamil II	2 0 0	2
24ENG110	Additional English II	2 0 0	2

MATHEMATICS FOR COMPUTING

Course Code	Title	L T P	Credit
24MAT131	Discrete Mathematics	3 1 0	4
24MAT132	Linear Algebra	3 1 0	4
24MAT133	Probability and Statistics	3 1 0	4
24MAT134	Statistical and Numerical Methods	3 1 0	4
24MAT135	Algebra and Number Theory	3 1 0	4
24MAT136	Mathematical Foundation	3 1 0	4
24MAT137	Foundations of Applied Mathematics - Part I	3 1 0	4
24MAT138	Foundations of Applied Mathematics - Part II	3 1 0	4

Open electives offered by the department

Course Code	Title	L T P	Credit
24OEL341	Introduction to Big Data and Cloud	3 0 0	3
24OEL342	Basics of Programming Using Python	3 0 0	3
24OEL343	Data Analytics and Visualization	3 0 0	3
24OEL344	Essentials of Cyber Security	3 0 0	3
24OEL345	The Art of Cryptography	3 0 0	3
24OEL346	Fundamentals of IoT	3 0 0	3
24OEL347	Introduction to AI	3 0 0	3
24OEL348	Introduction to Front Web development	3 0 0	3
24OEL349	Generative AI for Everyone	3 0 0	3
24OEL350	Introduction to relational databases	3 0 0	3
24OEL351	Networking Foundations	3 0 0	3
24OEL352	Data analysis using MS Excel	3 0 0	3
24OEL353	R Programming	3 0 0	3
24OEL354	Introduction to Crypto Currency and Block Chain	3 0 0	3
24OEL355	Basics of Linux Operating System	3 0 0	3
24OEL356	Administration and Automation with Windows Powershell	3 0 0	3

AMRITA VALUE PROGRAMMES FOR UG PROGRAMMES

Course Code	Title	L-T-P	Credits
22ADM201	Strategic Lessons from Mahabharatha	1-0-0	1
22ADM211	Leadership from Ramayana	1-0-0	1
22AVP210	Kerala Mural Art and Painting	1-0-0	1
22AVP201	Amma's Life and Message to the modern world	1-0-0	1
22AVP204	Lessons from the Upanishads	1-0-0	1
22AVP205	Message of the Bhagavad Gita	1-0-0	1
22AVP206	Life and Message of Swami Vivekananda	1-0-0	1
22AVP207	Life and Teachings of Spiritual Masters of India	1-0-0	1
22AVP208	Insights into Indian Arts and Literature	1-0-0	1
22AVP213	Traditional Fine Arts of India	1-0-0	1
22AVP214	Principles of Worship in India	1-0-0	1
22AVP215	Temple Mural Arts in Kerala	1-0-0	1
22AVP218	Insights into Indian Classical Music	1-0-0	1
22AVP219	Insights into Traditional Indian Painting	1-0-0	1
22AVP220	Insights into Indian Classical Dance	1-0-0	1
22AVP221	Indian Martial Arts and Self Defense	1-0-0	1
22AVP209	Yoga and Meditation	1-0-0	1

ELECTIVES
REGULAR STREAM

Professional Elective (I, II, III)

Course Code	Title	L T P	Credit
24CSA331	IoT Architectures and Programming	3 0 1	4
24CSA332	Computer Vision	3 0 1	4
24CSA333	Complex Network Analysis	3 0 1	4
24CSA334	Connected Internet of Things Devices	3 0 1	4
24CSA335	IoT and Cloud Computing	3 0 1	4
24CSA336	Semantic Web Technologies	3 0 1	4
24CSA337	Computer Graphics and Visualization	3 0 1	4
24CSA338	DevOps	3 0 1	4
24CSA339	Digital Image Processing	3 0 1	4
24CSA340	Advanced Computer Networks	3 0 1	4
24CSA341	Advanced Web Technologies and Mean Stack	3 0 1	4
24CSA342	Graph Theory and Combinatorics	3 0 1	4

Regular Elective (I, II, III, IV)

Course Code	Title	L T P	Credit
24CSA351	Advanced Operating Systems	3 0 0	3
24CSA352	Software Testing	3 0 0	3
24CSA353	Enterprise Resource Planning	3 0 0	3
24CSA354	Open-Source Systems	3 0 0	3
24CSA355	Parallel and Distributed Computing	3 0 0	3
24CSA356	Software Defined Networks	3 0 0	3
24CSA357	Embedded Systems	3 0 0	3
24CSA358	Robotic Operating System	3 0 0	3
24CSA359	Software Quality Assurance	3 0 0	3
24CSA360	Web Services	3 0 0	3
24CSA361	Linear Algebra and Applications	3 0 0	3
24CSA362	Database Administration	3 0 0	3
24CSA363	Information Science and Ethics	3 0 0	3
24CSA364	Mastering 5G/6G Technologies	3 0 0	3
24CSA365	Mobile Computing	3 0 0	3
24CSA366	Intellectual Property Rights	3 0 0	3
24CSA367	Computer Language Engineering	3 0 0	3
24CSA368	Linux System Administration	3 0 0	3
24CSA369	Research Methodology	3 0 0	3
24CSA370	Non-Relational Databases	3 0 0	3
24CSA371	Soft Computing	3 0 0	3
24CSA372	Optimization Techniques	3 0 0	3

DATA SCIENCE STREAM

Professional Elective (I, II, III)

Course Code	Title	L T P	Credit
24CSA431	Introduction to Business Analytics and Visualization	3 0 1	4
24CSA432	Data Modelling and Visualization	3 0 1	4
24CSA433	Exploratory Data Analysis	3 0 1	4
24CSA434	Big Data Analytics and Visualization	3 0 1	4
24CSA435	Natural Language Processing	3 0 1	4
24CSA436	Social Media Mining	3 0 1	4
24CSA437	Computational Biology	3 0 1	4
24CSA438	Text Mining And Analytics	3 0 1	4

Regular Elective (I, II, III, IV)

Course Code	Title	L T P	Credit
24CSA439	Automation and Robotics	3 0 0	3
24CSA440	Deep Learning	3 0 0	3
24CSA441	Time Series Analysis	3 0 0	3
24CSA442	Information Retrieval	3 0 0	3
24CSA443	Pattern Recognition	3 0 0	3
24CSA444	Recommendation Systems	3 0 0	3
24CSA445	Web Mining	3 0 0	3
24CSA446	Data Governance	3 0 0	3
24CSA447	Computational Intelligence	3 0 0	3
24CSA448	Business Intelligence	3 0 0	3
24CSA449	Artificial Intelligence	3 0 0	3

CYBER SECURITY STREAM

Professional Elective (I, II, III)

Course Code	Title	L T P	Credit
24CSA451	System Security	3 0 1	4
24CSA452	Web Application Security	3 0 1	4
24CSA453	Network Security	3 0 1	4
24CSA454	VAPT (Vulnerability and Penetration Testing)	3 0 1	4
24CSA455	Smart Contracts and Blockchain Security	3 0 1	4
24CSA456	Database Security Fundamentals	3 0 1	4

Regular Elective (I, II, III, IV)

Course Code	Title	L T P	Credit
24CSA457	Essentials of Cyber security	3 0 0	3
24CSA458	Malware Analysis	3 0 0	3
24CSA459	Blockchain and decentralized applications	3 0 0	3

Course Code	Title	L T P	Credit
24CSA460	Fundamentals of cyber security operations	3 0 0	3
24CSA461	Cloud and Infrastructure security	3 0 0	3
24CSA462	Cyber Security Law	3 0 0	3
24CSA463	Machine learning and artificial Intelligence in Cyber security	3 0 0	3
24CSA464	Mobile Security and Defense	3 0 0	3
24CSA465	Cyber Forensics	3 0 0	3
24CSA466	Security Architecture for Databases and Applications	3 0 0	3
24CSA467	Ethics and Data Privacy	3 0 0	3

LAB Elective (I, II, III)

Course Code	Title	L T P	Credit
24CSA381	Ethical Hacking	0 0 1	1
24CSA382	Python Scripting For Security	0 0 1	1
24CSA383	Android Programming	0 0 1	1
24CSA384	Competitive Programming	0 0 1	1
24CSA385	Edge Computing	0 0 1	1
24CSA386	R Programming	0 0 1	1
24CSA387	Matlab Programming	0 0 1	1
24CSA388	High Performance Computing	0 0 1	1
24CSA389	Cyber security Lab	0 0 1	1
24CSA481	Algorithms Lab	0 0 1	1
24CSA482	Xamarin Native Application Development	0 0 1	1
24CSA483	Asp.Net Core Restful Web Service Development	0 0 1	1
24CSA484	Flutter Application Development	0 0 1	1
24CSA485	Smart Programming	0 0 1	1

SEMESTER I

| 22ADM101 | FOUNDATIONS OF INDIAN HERITAGE | L-T-P-C:2-0-1-2 |

Course Objective(s)

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

COs	Description
CO1	Increase student understanding of true essence of India's cultural and spiritual heritage.
CO2	Emancipating Indian histories and practices from manipulation, misunderstandings and other ideological baggage thus, shows its contemporary relevance.
CO3	Understand the ethical and political strategic concepts to induce critical approach to various theories about India.
CO4	Familiarize students with the multi dimension of man's interaction with nature, fellow beings and society in general.
CO5	Appreciate the socio-political and strategic innovations based on Indian knowledge systems. Gives an understanding of bringing Indian teaching into practical life.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	2	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	1	2	-	-	-	3	-	-	-
CO3	2	-	-	-	-	2	3	3	-	-	-	-	-	-	-
CO4	-	-	3	-	3	2	3	-	-	-	-	3	-	-	-
CO5	2	-	1	2	-	1	3	1	-	-	-	2	-	-	-

Syllabus

1. Chapter 1 - Educational Heritage of Ancient India
2. Chapter 2 - Life and Happiness
3. Chapter 3 - Impact of Colonialism and Decolonization
4. Chapter 4- A timeline of Early Indian Subcontinent
5. Chapter 5 - Indian approach towards life
6. Chapter 6 - Circle of Life
7. Chapter 7- Pinnacle of Selflessness and ultimate freedom
8. Chapter 8- Ocean of love; Indian Mahatmas.
9. Chapter 9 - Become A Strategic Thinker (Games / Indic activity)
10. Chapter 10 - Man's association with Nature
11. Chapter 11 - Celebrating life 24/7
12. Chapter 12 - Metaphors and Tropes
13. Chapter 13 - India: In the Views of foreign Scholars and Travellers.

Self-Study/ Self-reading
14. Chapter 14 - Personality Development Through Yoga.
15. Chapter 15 - Hallmark ofIndian Traditions: Advaita Vedanta, Theory of oneness
16. Chapter 16 - Conversations on Compassion with Amma

Textbooks/References

    1.   Foundations of Indian Heritage

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course Objective:

To provide a general understanding of our environment, problems during exploitation of natural resources, the importance of biodiversity and the need for its conservation, pollution and its impacts, and approaches for environment sustainability.

Course Outcomes:

COs	Description
CO1	Understand the over-exploitation of our natural resources and the need for Sustainable development.
CO2	Understand the concept of ecosystem, its structure and function and threats to Ecosystems.
CO3	Understand the concept of bio-diversity, its importance and conservation.
CO4	Classify pollution and its impacts
CO5	Inferring different approaches for attaining environmental sustainability.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	1	1	1	0	1	1	1	1	1	1	0	0
CO2	1	1	0	1	1	1	1	1	2	1	1	1	1	1	1
CO3	1	1	0	1	1	1	1	1	2	1	1	1	1	1	1
CO4	2	2	0	1	1	1	1	1	2	1	1	1	1	1	1
CO5	2	2	1	2	2	2	1	2	2	1	1	1	1	2	2

Syllabus

Unit1

Multidisciplinary nature of environmental studies. Renewable and non-renewable Naturalresources. Overexploitation and conservation of the following natural resources -- forest,water,food,energy,mineral,andlandresources.Conceptofsustainability,sustainabledevelopment. Concept of three R's (Reduce, Reuse, and Recycle). Concept of zero waste.Needforenvironmentaleducation.

Unit2

Conceptofecosystem.Components,structureandfunctionofanecosystem.Abriefdescription of forest ecosystem and desert ecosystem. Food chain and food web, EcologicalPyramids.BiogeochemicalCycles(examples-Carbon,NitrogenandPhosphorous).EcosystemServices(exampleforest).
Threatstoecosystems.Conservationofecosystems.

Unit3

Concept of Biodiversity, hot spots of biodiversity, India as a mega diversity nation, Threats tobiodiversity, Value of biodiversity, Brief description of economic valuation of biodiversity,Red Data Base and Red data Book, International Union for Conservation of Nature **(IUCN)**Red ListofThreatened Species(Briefdescription),Conservationofbiodiversity.

Unit4

Pollution of air, acid rain, global warming and climate change, ozone layer depletion, Waterpollution, Soil pollution. Industrial and urban solid wastes, Hospital wastes, Hazardous waste,Collection, segregation of solid wastes, Different household disposal methods for degradablesolid wastes, Commercial water purification devices for households, Plastic pollution, microplasticsandits environmentalandhealtheffects.E-waste.

Unit 5

Ecological foot prints-brief description of Carbon Footprint and Water Footprint, Linear and Circular resource management, System thinking, Industrial ecosystems, Environmental Impact Assessment (EIA), Environment Management Plan (EMP), Green Technology, Green Business, Green Accounting, Green Buildings, Eco-Labeling, Sustainable (Green) Cities. Role of individuals in the up keeping of environment.

Text Books:

1. Palanisamy P. N., Manikandan P., Geetha A., Manjula Ran – Environmental Science, Pearson Education.
2. Harikumar P.N., Susha D. And Manoj Narayanan K. S. – Environment management and human rights.

Himalaya Publishing House.
3. Asthana D.K and Meera Asthana – A Textbook of Environmental Studies, S.Chand & Company Pvt Ltd. Ran Nagar, New Delhi -110055.

References:
1. Bala Krishnamoorthy – Environmental management: Text and Cases.PHI LearningPrivate Limited.
2. Jacob Thomas – Environmental management: Text and Cases. Pearson.
3. Rajagopaln R. – Environmental Studies: From crisis to cure. Oxford University Press

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Objectives:

To help students obtain an ability to communicate fluently in English; to enable and enhance the students' skills in listening, speaking, reading, and writing; to impart an aesthetic sense and enhance creativity

Cos	Course Outcomes
CO 1	Demonstrate competence in the mechanics of writing
CO 2	Summarise audio and written texts to convey messages effectively
CO 3	Apply mechanics of writing and AI tools to draft academic and professional documents
CO4	Organise ideas and thoughts for clear written and oral communication
CO 5	Critically evaluate literary texts

Unit I

Mechanics of writing - Parts of speech – use of prepositions, adjectives, adverbs and determiners – word order – collocation – concord (Subject-Verb, Pronoun-Antecedent) – kinds and patterns of sentences

Unit II

Tenses - Modal auxiliaries - Reported speech - Active and Passive Voice - Phrasal Verbs - Linkers/ Discourse Markers - Question Tags

Unit III

Pre-writing techniques - Paragraph writing – Cohesion – Development – types: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative - Introduction to the use of Gen AI in writing (AI tools, Do's and Don'ts while using AI, how to write prompts, etc.)

Unit IV

Listening comprehension (3 pieces – Do Schools kill creativity? By Sir Ken Robinson, Steve Jobs' 2005 Stanford Commencement Address, India Questions Dr Abdul Kalam- Aired August 2007) - Reading Comprehension – Skimming and Scanning- Inference and Deduction – Reading different kinds of material – Speaking**:** Narration of incidents / stories/ anecdotes.

Unit V

Shashi Tharoor – "'Kindly Adjust' to Our English

A. G. Gardiner – "A Fellow Traveller"

Ruskin Bond – "The Eyes Have It"

Mrinal Pande – "Girls"

W. H. Auden – "Unknown Citizen"

W H Davies - "Leisure"

References:

1. Murphy, Raymond, *Murphy's English Grammar,* CUP, 2004
2. Syamala, V. *Speak English in Four Easy Steps*, Improve English Foundation Trivandrum: 2006
3. Martinet, Thomson, *A Practical English Grammar*, IV Ed. OUP, 1986.
4. The Week - June 03, 2018, LAST WORD; https://www.theweek.in/columns/shashi-tharoor/2018/05/25/kindly-adjust-to-our-english.html?fbclid=IwAR3IhtdXqvuV4ySECn9S7SA6HmCEYISyd1QHd3BlwKgiNKKwdkeSg3qWp-U/
5. A G Gardiner – *Leaves in the Wind*, Digicat (e-book), 2015
6. Ruskin Bond – *The Best of Ruskin Bond*; India Penguin. April 2016.
7. Mrinal Pande – *Stepping Out*; Penguin India; 2003
8. W H Auden – *Another Time*; Random House Pub; 1940
9. William H Davies – *Songs of Joy and Others*; Andesite Press, August 2017.
10. Sir Ken Robinson – "Do schools kill creativity?". https://go.ted.com/6WoC
11. Steve Jobs' 2005 Stanford Commencement Address. https://youtu.be/UF8uR6Z6KLc?si=1nMNYJOk3Yw7H7tF
12. India Questions Dr Abdul Kalam (aired: August 2007). https://youtu.be/erg3CmVm6M4?si=YudsxXZOFY1do91C

24CSA101   COMPUTER FUNDAMENTALS AND DIGITAL ELECTRONICS   L-T-P-C: 3-0-1-4

Course Objective(s)
1. To provide an understanding of the fundamental components and functional units of a Digital Computer and its functionalities.
2. To provide the understanding of how to perform number conversions from one system to another system.
3. To To provide insight into digital systems and logic circuit design

Course Outcomes

COs	Description
CO1	Describe the basic components of computer systems and its functionality
CO2	Explain various number systems and its representations
CO3	Discuss about logic gates and boolean algebra
CO4	Design various combinational logic circuits
CO5	Develop various sequential circuits and their functions.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	1	-	-	1	-	-	1
CO2	3	1	-	-	-	-	-	-	1	-	-	1	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-	1
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO5	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1

Syllabus

Unit I
Computer Fundamentals: Brief history of Computer, Classification of Computers, Functions & Components of a Computer, Central Processing Unit, Storage units, Bus, Input and output Devices. Types of memory, RAM, ROM, Variants of ROM, Secondary storage devices- hard disk-disk components and geometry. Other Secondary Storage devices: CD/DVD Family, Blue ray Disc, Flash Drive, Memory stick, smart cards. Computer Languages- Machine, Assembly Language and Higher Level languages. Operating systems, Bootstrapping. Program execution with illustrative examples.

Unit II
Number Systems: Decimal Numbers, Binary Numbers, Decimal to Binary Conversions, Binary Arithmetic, 1's and 2's complements of Binary Numbers, Signed Numbers, Arithmetic Operations with Signed numbers, Hexadecimal Numbers, Octal Numbers and Error Detection Codes.

Unit III
LOGIC GATES: The NOT gate, The AND gate, The OR gate, The NAND gate, NOR gate, The Exclusive–OR gate and Exclusive-NOR gate; Boolean algebra - Basic laws and theorems, Boolean functions, truth table, minimization of boolean function using K map method and SOP minimizations.

Unit IV
Logic Circuits: Combinational logic circuits: Half adder, Full adder, Parallel binary adder, subtractor, Decoders, Encoders, Multiplexers, De-multiplexers. Sequential logic circuits- Flip Flops – RS, JK, T and D Flip Flops, Edge triggered Flip Flops, Master slave Flip Flops.
Registers and Counters: Serial in serial out, Serial in Parallel out, Parallel in serial out, Parallel in Parallel out registers, Bidirectional shift registers. Introduction to counters and applications.

Lab Syllabus:
Introduction to Computer Fundamental and Communication, Various components of a computer, Installing Windows operating system on a system, Installing Linux operating system on a system, Basics of digital electronics, Basic gates and Universal Gates, Half Adder and Full Adder, Half Subtractor and Full Subtractor, Encoder and Decoder, Multiplexer, Demultiplexer, Types of Multiplexers: 4:1, 8:1 and 16:1, Project Presentation and Document submission

Textbooks
1. Floyd, Thomas L: Digital Computer Fundamentals, 11th Edition, Pearson International, 2015.
2. Morris Mano, "Digital logic and Computer design", First Edition, Prentice Hall of India, (2004).

References

1. Malvino, Paul Albert, Leach, Donald P,GautamSaha: Digital Principles And Applications, TMH ,8th Edition, 2015.
2. Bartee, Thomas C: Digital Computer Fundamentals, 6Edition,TMH, 2010.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA102   PROBLEM SOLVING AND COMPUTER PROGRAMMING USING C   L-T-P-C: 3-0-0-3

Course Objective(s)
- Learn the foundations of computational problem solving with algorithm thinking.
- To provide basic concepts of the C-programming and use of language constructs for problem solving using C language.
- Covers the usage of pointers, structures & functions for developing applications in C.

Course Outcomes

COs	Description
CO1	Learn fundamental programming concepts needed to develop computer programs.
CO2	Code, debug and execute a well-structured basic computer program using the C language..
CO3	Given a programming problem, design a solution and identify the C programming constructs needed for the solution and implement it in C language
CO4	Understand and explain different constructs like arrays, pointers and structures and apply it for solving computational problems.
CO5	Develop reusable modules using functions and write programs for file handling.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	2	-	-	-	3	-	-	1
CO2	-	-	-	-	-	-	1	2	-	-	-	3	-	1	-
CO3	2	-	-	-	-	2	3	3	-	-	-	-	-	1	-
CO4	-	-	3	-	3	2	3	-	-	-	-	3	-	-	1
CO5	2	-	1	2	-	1	3	1	-	-	-	2	-	1	-

Syllabus
Unit I

Problem Solving - understand problem definition, constraints on input/output, sample input and expected output; Algorithmic thinking - reading input/writing output, data representation, choice of data types, formulating solutions to basic problems;

Introduction to C language - structure of _C' program, Programming elements(tokens) –Classes of data types – Declaration of variables, assigning values to variables, Input and Output operations – printf, scanf, escape sequences (backslash character constants), Specifying Comments, Operators–operator precedence and associativity, Expressions – Evaluation of expressions, type conversions(type casting).
Unit II

Control Flow - Decision Control and Loop Control, Decision Control Instructions – if-else , nested if-else, Use of logical operators in decision making, Switch control structure, Loop Control Instructions -While, for, dowhile, nested loops.
Unit III

Arrays – single dimensional arrays - declaration –memory representation– initialization and access. 2D arrays and multidimensional arrays. Strings – defining strings, reading strings from standard input, initializing, accessing, character handling functions, arithmetic operations on characters, character by character input and output, string handling functions, array of strings and its features.

Pointers –Introduction, declaring and initializing pointer variables, pointer expressions, pointers and arrays, pointers and strings, array of pointers.
Unit IV

Functions – definition-declaration-prototypes and function call- actual and formal arguments-types of functions- call by value-call by reference-nesting of functions-recursive functions-pointers to functions-storage class specifiers. Enumerated data types, Preprocessor directives – Macros - Defining symbolic constants, File inclusion, Command line arguments.

Unit V

Structures – definition, declaration, initialization, accessing structures, array of structures, array within structures, structures within structures, self-referential structures, pointers to structures, uses of structures; Union – definition, union of structures; Files – Reading and writing files, file handling functions, file opening modes, file operations

Textbooks / References:
1. "Let us C", Yashavant Kanetkar, 13th Edition, BPB Publications.
2. "Programming in ANSI C", E. Balagurusamy, 6th Edition, Tata McGraw-Hill Publishing Company Limited.
3. "C Programming Language" Brian W Kernighan, Dennis M Ritchie Second Edition, Prentice Hall.
4. "Test your C Skills", Yashavant Kanetkar.
5. "Exploring C", Yashavant Kanetkar

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA181   PROBLEM SOLVING AND COMPUTER PROGRAMMING USING C LAB   L-T-P-C: 0-0-1-1

Course Objective(s)
- Understand the principles and methods of computational problem solving thereby providing transferable skills to any other domain.
- Familiarize yourself with the hands-on experience on developing applications using different constructs in C language.

Course Outcomes

COs	Description
CO1	Enhance problem solving skills and use it for solving computational problems.
CO2	Design, implement, test, debug, and document moderately complex programs in C.
CO3	Implement C programs using functions, pointers and structures
CO4	Use files and file operations to build data handling applications in C.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-		-	-	-	1	3	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	2	3	-	-	1
CO3	3	1	-	-	-	-	-	-	-	-	1	3	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	1	3	1	-	-

Syllabus
Basic C program and its execution- Installation of a C compiler and familiarisation of its usage, C program to print message on the console, variable declaration and initialisation, reading values from standard input. Usage of format specifiers for printing values. Operators- Arithmetic, Relational, Ternary, Logical, Bitwise Control Statements-if, if-else, nested if, if-else if, switch, goto Looping Control-while, for, do-while Arrays-one-dimensional- creating, displaying merging, searching, sorting, reversing Arrays-Two-dimensional- creating, displaying, Operations on 2D arrays Strings-String functions, manipulation of strings, multi strings Pointers – Pointer arithmetic, Array of pointers, pointer to array Functions – passing arguments, returning values, recursive functions, pointers as arguments Structures-Initializing, members as array, variables as array, passing structures to functions, pointers to structures Union-Enum types, preprocessors-macros, macro with arguments, nested macro, file inclusion, command line arguments File Handling

Textbooks
1. Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27
2. Let us C", Yashavant Kanetkar, 13th Edition, BPB Publications.
3. Programming in ANSI C, E. Balagurusamy, 6thEdition, Tata McGraw-Hill Publishing Company Limited.

References
1. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
2. C Programming Language" Brian W Kernighan, Dennis M Ritchie Second Edition, Prentice Hall.
3. "Test your C Skills", Yashavant Kanetkar

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

Course Objective(s)

To familiarize students with the architecture of Linux OS and implementation of various applications in Operating Systems. Provides necessary skills for developing and debugging programs in linux environment

Course Outcomes

COs	Description
CO1	Demonstrate the general purpose and file management commands in Linux
CO2	Practice with user management, authentication and access control in Linux
CO3	Experimenting with process and system management commands in Linux
CO4	Show how networking and package management is obtained in Linux
CO5	Demonstrate setting the Linux environment variables and various types of shells

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	1	-	-	-	-	-	-	2	1	-	2	-	-
CO2	1	-	1	-	-	-	-	-	-	2	2	-	2	-	-
CO3	1	-	1	-	-	-	-	-	-	2	2	-	2	-	-
CO4	1	-	1	-	-	-	-	-	-	2	2	-	2	-	-
CO5	1	1	1	-	-	-	-	-	-	1	1	-	2	-	-

Syllabus

Introduction to Linux Operating System, history, overview of features, shells, Linux releases and distributions, General purpose utilities – cal, date, echo, bc, pwd, tty, stty, ls, man, who , whoami. Text editors :gedit,vi,nano

File management in Linux: Linux file structure, file types, navigating the file system, listing files and directories, file management commands: cat, mkdir, touch, cp, rm, mv, rmdir, less,more, head, tail, wc, cmp, hardlink and softlink, Pipes (|) , Standard output to a file (tee command) , Compare Files (diff, cmp), Compress and un-compress files/directories (tar, gzip, gunzip), grep, sed, awk.

File ownership, File permissions & access control, working with user permissions - chmod: Changing file, permissions, directory permission, Changing file ownership, chown: Changing file owner, chgrp: Changing group owner. User management commands: useradd, passwd, usermod, userdel, Switch users and Sudo access, Monitor users, Talking to users (users, wall, write).

Processes and schedules: systemctl, ps, top, kill, crontab and at, System Monitoring Commands: top, df, dmesg, iostat 1, netstat, free, OS Maintenance Commands - shutdown, reboot, halt, init. Changing System Hostname (hostnamectl), Finding System Information (uname, cat /etc/redhat-release, cat /etc/*rel*, dmidecode), System Architecture (arch), Storage management, Disk partition- df, fdisk.

Network files and commands: ping, ifconfig, configuring IP using GUI, NIC Information – ethtool, Download files with URLs -wget, curl and ping commands to check connectivity, Hostname and IP Lookup - nslookup and dig, traceroute, System updates and repositories – rpm/yum.

Shell: bash, login shell, bash scripts, writing and running small scripts, environment variables, shell configuration files, file path, PATH environment variable.

Textbooks /References
1. Linux: A Complete Guide to Learn Linux Commands, Linux Operating System and Shell Scripting Step-by-Step, by Nicholas Ayden,
2. Learn Linux Quickly: A Comprehensive Guide for Getting Up to Speed on the Linux Command Line (Ubuntu), Crawford Press, 20 January 2021
3. A Practical Guide to Linux Commands, Editors, and Shell Programming, Fourth Edition, Mark G. Sobell, Matthew Helmke, November 2017, Pearson
4. Begining Linux Programming, 4th Edition, N. Matthew, R.Stones, Wrox, Wiley India Edition.

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

22AVP103　　　　**Mastery Over Mind (MAOM)**　　　　**1-0-2 2**

1. Course Overview

Master Over the Mind (MAOM) is an Amrita initiative to implement schemes and organise university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3). This program as part of our efforts for sustainable stress reduction gives an introduction to immediate and long-term benefits and equips every attendee to manage stressful emotions and anxiety facilitating inner peace and harmony.

With a meditation technique offered by Amrita Chancellor and world-renowned humanitarian and spiritual leader, Sri Mata Amritanandamayi Devi (Amma), this course has been planned to be offered to all students of all campuses of AMRITA, starting off with all first years, wherein one hour per week is completely dedicated for guided practical meditation session and one hour on the theory aspects of MAOM. The theory section comprises lecture hours within a structured syllabus and will include invited guest lecture series from eminent personalities from diverse fields of excellence. This course will enhance the understanding of experiential learning based on university's mission: "Education for Life along with Education for Living", and is aimed to allow learners to realize and rediscover the infinite potential of one's true Being and the fulfilment of life's goals.

2. Course Syllabus

Unit 1 (4 hours)

Causes of Stress: The problem of not being relaxed. Need for meditation -basics of stress management at home and workplace. Traditions and Culture. Principles of meditation– promote a sense of control and autonomy in the Universal Human Value System. Different stages of Meditation. Various Meditation Models. Various practices of Meditation techniques in different schools of philosophy and Indian Knowledge System.

Unit 2 (4 hours)

Improving work and study performance. Meditation in daily life. Cultivating compassion and good mental health with an attitude of openness and acceptance. Research and Science of Meditation: Significance of practising meditation and perspectives from diverse fields like science, medicine, technology. philosophy, culture, arts, management, sports, economics, healthcare, environment etc. The role of meditation for stress and anxiety reduction in one's life with insights based on recent cutting-edge technology. The effect of practicing meditation for the wholesome wellbeing of an individual.

Unit 3 (4 hours)

Communications: principles of conscious communication. Relationships and empathy: meditative approach in managing and maintaining better relationships in life during the interactions in the world, role of MAOM in developing compassion, empathy and responsibility, instilling interest, and orientation to humanitarian projects as a key to harness intelligence and compassion in youth. Methodologies to evaluate effective awareness and relaxation gained from meditation. Evaluating the global transformation through meditation by instilling human values which leads to service learning and compassion driven research.

TEXT BOOKS:
1.Mata Amritanandamayi Devi, "Cultivating Strength and vitality," published by Mata Amritanandamayi Math, Dec 2019
2.Swami Amritaswarupananda Puri ,"The Color of Rainbow " published by MAM, Amritapuri.

 REFERENCES:
1.Craig Groeschel, "Winning the War in Your Mind: Change Your Thinking, Change Your Life"

Zondervan Publishers, February 2019

2. R Nagarathna et al, "New Perspectives in Stress Management "Swami Vivekananda Yoga Prakashana publications, Jan 1986

3. Swami Amritaswarupananda Puri "Awaken Children Vol 1, 5 and 7 - Dialogues with Amma on Meditation", August 2019

4. Swami Amritaswarupananda Puri "From Amma's Heart - Amma's answer to questions raised during world tours" March 2018

5. Secret of Inner Peace- Swami Ramakrishnananda Puri, Amrita Books, Jan 2018.

6. Mata Amritanandamayi Devi "Compassion :The only way to Peace:Paris Speech", MA Center, April 2016.

7. Mata Amritanandamayi Devi "Understanding and collaboration between Religions", MA Center,   April 2016.

8. Mata Amritanandamayi Devi "Awakening of Universal Motherhood: Geneva Speech" M A center, April 2016.

3. Evaluation and Grading

Internal			External	Total
Components	*Weightage*		Practical (attendance and class participation) 60%	100%
Quizzes(based on the reading material)	20%	40%		
Assignments (Based on webinars and lecture series)	20%			

4. Course Outcomes (CO)

CO1: Relate to the causes of stress in one's life.
CO2: Experiment with a range of relaxation techniques CO3: Model a meditative approach to work, study, and life.
CO4: Develop appropriate practice of MA-OM technique that is effective in one's life CO5: Inculcate a higher level of awareness and focus.
CO6: Evaluate the impact of a meditation technique

*Programme Outcomes(PO)(As given by NBA and ABET)
PO1: Engineering Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Engineer and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

CO – PO Affinity Map

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2		-	2	3	-	3	-	3	-	-	-
CO2	3	3	3	2	2	_	2	3	3	3	-	3	-	-	-
CO3	3	3	2	2	2	2	2	3	3	3	-	3	-	-	-
CO4	3	3	3	2	-	2	3	3	3	3	-	3	-	-	-
CO5	3	2	2	2	-	2	-	3	2	2	-	2	-	-	-
CO6	3	2	2	2	3	2	_	3	2	2	-	2	-	-	-

22ADM111	GLIMPSES OF GLORIOUS INDIA	L-T-P-C:2-0-1-2

Course Objective(s)

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

COs	Description
CO1	This part deals with two topics: The Need to Become Fearless in Life and the Role or Status of Women in India.
CO2	This part deals with three topics: Teachings and Principles of Chanakya, Difference between the terms God and Iswara and Contribution of Bhagavad Gita
CO3	This area handles two important concepts: Indian Soft powers and A portrayal of how nature was pre-served through the medium of Faith. Inner power is about never giving up on your dreams. To manifest more of what you desire in life, you must be prepared to embrace your inner power. You must be persistent if you wantto succeed. Maintain your modesty and never stop learning. Inner strength is an attitude to life. Faiths shape and direct how we think, act, and live our lives. However, faith's power is not solely spiritual. To preserve nature, our forefathers established systems and traditions based on faith. Our culture and faith are intricately bound to nature.
CO4	Two important topics are discussed here: A Brief history of Ancient Indian Cultures and a Discussion on Practical Vedanta. Indian culture is the legacy of the ethno-linguistically diverse country's social norms, moral principles, traditional practices, belief systems, political systems, artefacts, and technologies. Following every invasion or change of political control, new kingdoms carried their respective cultures with them, adding to the Indian culture. Vedanta is the philosophy of the Upanishads. Every soul possesses the potential to be divine. The objective is to manipulate this inner divinity by invoking both internal and external natural forces.
CO5	From this part, a student gets an insight into the contribution that India has made to the world. Moreover, foreign powers have been trying to humiliate and degrade India in front of the world for so long. However, it should be recognized that many inventions that are considered beneficial to the world today have been contributed by the great men of India.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	2	2	-	-	-	3	-	-	3	-	-	-
CO2	-	-	2	-	-	-	-	2	2	-	-	2	-	-	-
CO3	-	-	3	-	2	-	3	2	2	-	-	3	-	-	-
CO4	-	-	1	-	-	-	1	1	-	-	1	-	-	-	-
CO5	2	-	-	1	1	-	2	-	-	-	3	3	-	-	-

Syllabus

1. Chapter 1 - Face the Brutes
2. Chapter 2 - Role of Women in India
3. Chapter 3 - Acharya Chanakya
4. Chapter 4 - God and Iswara
5. Chapter 5 - Bhagavad Gita: From Soldier to Samsarin to Sadhaka

6. Chapter 6 - Lessons of Yoga from Bhagavad Gita
7. Chapter 7 - Indian Soft Powers: A Solution For Many Global Challenges
8. Chapter 8 - Nature Preservation through faith
9. Chapter 9 - Ancient Cultures what happened to them.
10. Chapter 10 - Practical Vedanta
11. Chapter 11 - To the World from India
12. Chapter 12 - IndianApproach to Science

Textbooks/References
1. Glimpses Of Glorious India

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24ENG111   **English II**   **1 0 2 2**
Objectives:

To train students to convey and document information in a formal environment; to facilitate them to acquire the skill of self-projection in professional circles; to inculcate critical and analytical thinking.

Cos	Course Outcomes
CO 1	Illustrate comprehension of the fundamentals of writing
CO 2	Analyse audio text focussing on English phonetics, pronunciation and meaning comprehension
CO 3	Apply theoretical knowledge to write professional documents
CO 4	Infer from current news to formulate ideas and opinions
CO5	Prepare appropriate content for mini project and make effective presentation

Unit I

Vocabulary Building: One-word substitutes; Antonyms and Synonyms; Words often Confused Error Analysis (Subject-Verb Agreement; Tense Sequence; Usage of Articles and Prepositions; Determiners; Redundancy); Modifiers (misplaced, dangling, etc.)

Unit II

Circulars; Memos; Formal Letter writing; e-Mail Etiquette; Instruction, Suggestion & Recommendation; Essay writing: Analytical and Argumentative

Unit III

Sounds of English: Stress, Intonation - Listening Comprehension (3 pieces – Women in Technology Panel discussion, India Questions Abdul Kalam, UPSC Topper Mock interview Akshat Jain) - Current News Awareness

Unit IV

Reports: Incident Report, Event Report

Situational Dialogue; Group Discussion (Opinion)

Unit V

Mini Project and Presentation

References:

1. Felixa Eskey. *Tech Talk*, University of Michigan. 2005
2. Michael Swan. *Practical English Usage*, Oxford University Press. 2005
3. Anderson, Paul. *Technical Communication: A Reader Centered Approach*, V Edition, Hercourt, 2003   .
4.   Martinet, Thomson, *A Practical English Grammar*, IV Ed. OUP, 1986.
5. Raymond V. Lesikar and Marie E. Flatley. *Basic Business Communication*, Tata

   McGraw Hill Pub. Co. New Delhi. 2005. Tenth Edition.

6. Thampi, G. Balamohan. *Meeting the World: Writings on Contemporary Issues*. Pearson, 2013.
7. Lynch, Tony. *Study Listening*. New Delhi: CUP, 2008.
8. Kenneth, Anderson, Tony Lynch, Joan Mac Lean. *Study Speaking*. New Delhi: CUP, 2008.
9. Marks, Jonathan. *English Pronunciation in Use*. New Delhi: CUP, 2007.
10. Syamala, V. *Effective English Communication for You (Functional Grammar, Oral and Written Communication)*: Emerald, 2002.
11. Sample Question Papers from Competitive Examinations
12. Women in Technology Panel discussion
        https://youtu.be/T44XdGH5s-8?si=A1cDVEt777FH7vFR

13. India Questions Abdul Kalam
        https://youtu.be/erg3CmVm6M4?si=WjP_SV1vy6FrsGHg

14. UPSC Topper Mock interview, Akshat Jain
        https://youtu.be/lsJBGvyiAHI?si=L-u6kTadzJmghHLI

24CSA111	**DATABASE MANAGEMENT SYSTEM**	L-T-P-C: 3-0-0-3

Course Objective(s)
- To present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Outcomes

COs	Description
CO1	Master the basic concepts of DBMS and its types. Understand the concepts of data independence and three schema architecture.
CO2	Be familiar with the CODD's rules and E-R Model and also have clear picture about the structure of the relational databases.
CO3	Master the concept of normalization and different types of normalization. Design normalised database objects and process the data in an optimized way.
CO4	Be familiar with the basics of query evaluation techniques and query optimization and to get a clear picture about transaction processing.
CO5	Comprehend the conversion of queries into relational algebra and to construct query transactions having atomic, consistent, isolated and durable properties.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	-	1	-	2
CO2	3	3	-	-	-	1	-	1	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	1	-	-	-	1	-	1	-	1
CO4	3	3	2	-	1	-	-	-	1	-	-	-	1	-	1
CO5	3	3	2	-	-	-	-	-	-	1	-	1	-	-	1

Syllabus

Unit I

Introduction to Data and Database. Significance of Database Management System, Various Types of DBMS. Data Independence - The Three Levels of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure, Instance and Schema.

Unit II

Keys - CODD's Rules, Design Issues -ER – Model –Attribute types- Weak Entity Sets - Extended ER Features –ER to Relational Mapping, Structure Of Relational Databases, Creation and Manipulation of Database using Basic SQL(DDL, DML,DCL,TCL)

Unit III

Normalization –Anomalies- Functional Dependency: Armstrong's axioms- closure of a relation and closure of attribute– Lossless decomposition-1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit IV

The Relational Algebra -- Query Processing and Optimization: Evaluation of Relational algebra expressions-Query Equivalence-Transaction Processing: ACID properties, states of a transaction- Introduction to concurrency control-Deadlock-Recovery.

Textbooks/ References
1. Silberschatz Korth. Sudarshan: Database System Concepts - 6thEdition Mcgraw-Hill International Edition
2. Ivan Bayross: Sql- PL/SQL The Programming Language of Oracle- 4rd Edition- Bpb Publications
3. C.J. Date: An Introduction To Database Systems - Eighth Edition - PearsonEducation Asia
4. Kevin Loney - George Koch: Oracle 9i The Complete Reference Mcgraw-Hill International Edition
5. "Fundamentals of Database Systems" by Elmasri and Navathe

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)

The course aims to provide a thorough understanding of the core concepts of object-oriented programming, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction. Students will grasp the principles behind OOP and learn how to apply them effectively in Java.

Course Outcomes

COs	Description
CO1	Identify classes, objects, members of a class and relationships among them needed for a specific problem.
CO2	Write Java application programs using OOP principles and proper program structuring.
CO3	Demonstrate the concepts of polymorphism, inheritance and thread and document a Java Program using Javadoc.
CO4	Implement Generics and Collection Framework.

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO3	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	2	1	-	-	-	-	-	-	-	-	-	-	1	-

Syllabus

Unit I

Java Fundamentals, Introduction to Classes, Objects and Methods, Object Oriented Concepts, Inheritance, Polymorphism, Abstract Classes & Interfaces.

Unit II

Exception Handling, Using I/O - Streams, read and write binary files, character streams for file I/O

Unit III

Introduction to Threads, Creating Threads, Thread States, Runnable Threads, Coordinating Threads, Interrupting Threads, Runnable Interface, Synchronization.

Unit IV

Collection framework, Generics, Lambda Expressions – expression lambdas, block lambdas, Method & Constructor References.

Textbooks

1. Herbert Schildt, "Java, A Beginner's Guide", Ninth Edition, McGraw-Hill Education, 2022

References

1. Ali Bahrami, "Object Oriented Systems Development", Second Edition, McGraw-Hill,2008.
2. Jaime Nino, Fredrick a Hosch, "An Introduction to Programming and Object-Oriented Design using Java", Wiley India Private Limited, 2010 Herbert Schildt, "Java: The Complete Reference, Eleventh Edition", Oracle 2018

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA183	**DATABASE MANAGEMENT SYSTEM LAB**	**L-T-P-C: 0-0-1-1**

Course Objective(s)
- The objective of this lab course is to understand the practical applicability of database management system concepts.
- Working on existing database systems, designing of database, creating relational database, analysis of table design.

Course Outcomes

COs	Description
CO1	Master the basic commands of SQL and its usage
CO2	Design tables and insert Relevant data for query manipulation
CO3	Understand the application of SQL functions, sub queries and joins
CO4	Construct interactive PL/SQL programs for database applications

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	-	1	-	-	-	-	-	-	-	1	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	-	1	-	2
CO3	2	3	3	-	-	-	-	-	-	-	-	-	1	-	2
CO4	2	3	3	-	1	-	-	-	1	-	-	-	2	-	2

Syllabus

Basic SQL Commands DML- Select, insert, Delete DDL Commands-Create, Drop, Alter
Built in SQL functions- Set operations, Sub Queries-Joins-DCL – TCL- Views – Sequences – Index – Locks
PL/SQL Basics – Exceptions – Cursors - Stored Functions – Triggers Programming with PL/SQL

Textbooks/ References
1. Silberschatz Korth. Sudarshan: Database System Concepts - 6thEdition Mcgraw-Hill International Edition
2. Ivan Bayross: Sql- PL/SQL The Programming Language of Oracle- 4rd Edition- Bpb Publications
3. C.J.Date: An Introduction To Database Systems - Eighth Edition - PearsonEducation Asia
4. Kevin Loney - George Koch: Oracle 9i The Complete Reference Mcgraw-Hill International Edition
5. "Fundamentals of Database Systems" by Elmasri and Navathe Edition 7

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

24CSA184	OBJECT ORIENTED PROGRAMMING USING JAVA LAB	L-T-P-C: 0-0-1-1

Course Objective(s)

- The course aims to provide a thorough understanding of the core concepts of object-oriented programming, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction. Students will grasp the principles behind OOP and learn how to apply them effectively in Java.

Course Outcomes

COs	Description
CO1	The skills to apply OOP in Java programming in problem solving.
CO2	Write a complete class definition and within the class definition, write constructor and overloaded
CO3	Conceptualize, Analyze and write programs to solve more complicated problems using the concepts of multi-threading and Exception handling. .
CO4	Conceptualize, Analyze and write programs to solve more complicated problems using the concepts of multi-threading and Exception handling.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1

Syllabus

Input / Output statements, Manipulators, Structures, Classes, Objects, Static members and functions, Constructors and destructors, Constructor overloading, Function overloading, Forms of inheritance, Exception handling, Interfaces, Multithreading, Thread Synchronization, Generics, Collection Framework, AWT, Swing, Event Handling, Lambda Expressions.

Textbooks

1. Herbert Schildt, "Java, A Beginner's Guide", Ninth Edition, McGraw-Hill Education, 2022

References

1. Ali Bahrami, "Object Oriented Systems Development", Second Edition, McGraw-Hill,2008.
2. Jaime Nino, Fredrick a Hosch, "An Introduction to Programming and Object-Oriented Design using Java", Wiley India Private Limited, 2010
3. Herbert Schildt, "Java: The Complete Reference, Eleventh Edition", Oracle 2018

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

24CSA185	USER INTERFACE DESIGN	L-T-P-C: 0-1-1-2

Course Objective(s)

The objective of the course is to learn practical principles and guidelines needed to develop high quality interface designs

Course Outcomes

COs	Description
CO1	Understand the Usability of Interactive Systems
CO2	Understand Guidelines and Principles
CO3	Demonstrate and Practice the ability to design interfaces
CO4	Demonstrate and Practice the ability to document and present solutions
CO5	Evaluate and critique digital media designs and projects

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	-	-	-	1	1	-	-	1	-
CO2	2	3	3	1	1	-	-	-	2	1	1	-	2	-	1
CO3	2	3	2	1	1	-	3	-	1	1	2	1	2	-	-
CO4	3	-	1	-	-	-	-	1	-	1	3	1	-	-	1
CO5	3	2	2	1	1	-	-	-	2	1	1	1	2	-	-

Syllabus

Unit-1

Introduction:UsabilityGoalsandMeasures,UsabilityMotivations,UniversalUsability,Goals for our Design Profession. Guidelines, Principles, and Theories of Design.

Unit-2

Managing Design Process: Organizational Design to support Usability, The four Pillars of Design,DevelopmentMethodologies,Participatorydesign,ScenarioDevelopment,Legal Issues.

Unit-3

Interaction Styles: Examples of direct Manipulation, discussion of Direct Manipulation, 3D interfaces, teleoperation, Virtual and Augmented Reality. Task related menu organization, single menus, combinations of multiple menus, content organization, fast movement through menus, Data entry with Menus, audio menus and menus for small displays.

Unit-4

CommandandNatural Languages: Introduction, Command Organization functionality, strategies and structure, naming and abbreviations, Natural language in

computing. InteractionDevices.Keyboardsandkeypads,Pointingdevices,speechandauditoryinterfaces, displays-smalland large.

Unit-5

CollaborationandSocialMediaParticipation : Introduction, Goals of collaboration and participation, Asynchronous Distributed Interfaces: Different Place, Different Time, different time,Synchronous Distributed Interfaces: Different Place, Same Time, Face-to-Face Interfaces: Same Place, Same Time.

Unit-6

CaseStudy/Tools/DesignLab

Case study based on domain-web-mobile-product interaction-software tools-mockups- interactive design. Learn through cheat-sheets - AdobeXD-Figma-UXPin-Portfolio creation through behance.net

List of Lab Programs

1. Design a touch screen kiosk that displaying customer information for a large international bank anduse appropriate icons for accessing information.While using icons follow the various guidelines and consistency factors for the same.

2. Design a mobile application for furniture information system that gives various furniture information to its users. For that select appropriate menu structure and use it as per various guidelines andfollow consistency foratleast 5 components such as Menutitle,Errormessages,Menustatusreport,MenuInstructions,Functionkeyusageof menus etc.

3. Designasystemthatwillhelpsusertocheckrepharse,speak,write,personalTrainerand settings in document.

4. Design a system that will helps user to perform translate,define,synonyms,personal dictionary and help center in document.
5. Design a social media application that dealt with sharing educational information and personal information among social media users.

6. Design a bank application that consist A/c holders information,Type of Account,and transactiondetailsfortheircustomersanduseappropriatewindowsanditsfeaturesfor easy access for users.
7. Designa form that enablesyou to apply passport inthepassport authority ofIndia

8. Design any two web browser screens that helps its users for accessing various information including images and video linksand it includes various general icon options,applicationbasediconsandvariousothergeneraloptions.Followtheiconrules for the same
9. DesignanUIDscreenforanapplicationthatgivesyouinformationaboutastudenthostel.Use appropriate menus,icons,Logo,font style and sizes wherever required.

Text Books And Reference Books
1. Shineiderman,Plaisant,Cohen,Jacobs,DesigningtheUserInterface-Strategiesfor Effective Human-Computer-Interaction, Pearson Education, 5th Edition, 2010.

EssentialReading/RecommendedReading
1. AlanDix,Human-ComputerInteraction,Pearson Education,2009.
2. Wilber O Galitz, An Introduction to GUI Design Principles and Techniques, John- Wiley & Sons, 2007.

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

23LSK201	Life Skills I	L-T-P-C: 1-0-2-2

Pre-requisite: An open mind and the urge for self-development, basic English language skills, knowledge of high school level mathematics.

Course Objective: To assist students in inculcating soft skills, developing a strong personality, empowering them to face life's challenges, improving their communication skills and problem-solving skills.

Course Outcomes
CO1: Soft Skills - To develop greater morale and positive attitude to face, analyze, and manage emotions in real life situations, like placement process.
CO2: Soft Skills - To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.
CO3: Aptitude – To analyze, understand and solve questions in arithmetic and algebra by employing the most suitable methods.
CO4: Aptitude - To investigate and apply suitable techniques to solve questions on logical reasoning.
CO5: Verbal – To infer the meaning of words & use them in the right context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.
CO6: Verbal - To identify the relationship between words using reasoning skills. To develop the capacity to communicate ideas effectively.
Skills: Communication, self-confidence, emotional intelligence, presentation skills and problem-solving Skills.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	3	3	-	3
CO2	-	-	-	-	-	-	-	3	2	3	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	3	-	3
CO6	-	-	-	-	-	-	-	-	3	3	-	3

Syllabus
Soft Skills
Soft Skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback. Need for change in mindset and up-skilling to keep oneself competent in the professional world.
Managing Self: Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up-gradation / Life-long learning. Personal productivity - Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.
Communication: Process, Language Fluency, Non-verbal, Active listening. Assertiveness vs. aggressiveness. Barriers in communication. Digital communication

Aptitude
Numbers: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.

Percentage: Basics, Profit, Loss & Discount, and Simple & Compound Interest.

Ratio, Proportion & Variation: Basics, Alligations, Mixtures, and Partnership.

Averages: Basics, and Weighted Average.

Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.

Logical Reasoning I: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding \& Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Verbal Skills

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misused words, commonly confused words and wrong form of words in English.

Grammar (Basics): To learn the usage of grammar and facilitate students to identify errors and correct them.

Reasoning: Stress the importance of understanding the relationship between words through analogy questions. Emphasize the importance of avoiding the gap (assumption) in the argument/ statements/ communication.

Speaking Skills: Make students conscious of the relevance of effective communication in today's world through individual speaking activities.

Writing Skills: Introduce formal written communication and keep the students informed about the etiquette of email writing.

References:
1. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
2. The hard truth about Soft Skills, by Amazon Publication.
3. Verbal Skills Activity Book, CIR, AVVP
4. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
5. The BBC and British Council online resources
6. Owl Purdue University online teaching resources
7. www.thegrammarbook.com online teaching resources
8. www.englishpage.com online teaching resources and other useful websites
9. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
10. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
11. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
12. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
13. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
14. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
15. A Modern Approach to Logical Reasoning, R S Aggarwal.
16. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**

24CSA201	**DATA STRUCTURES**	L-T-P-C:3-1-0-4

Course Objective(s)
- To provide knowledge of basic data structures and their implementation
- To get familiarized with linear data structures and their applications
- To understand the concepts of nonlinear data structures and their applications
- To understand the importance of data structures for writing efficient programs and to apply appropriate data structures in problem-solving

Course Outcomes

COs	Description
CO1	Ability to apply basic data structures like arrays and linked list for various applications
CO2	Illustrate the concepts of stack and its applications
CO3	Design algorithms using queue, their types, and the applications
CO4	Apply the concepts of non-linear data structures like graphs and trees to solve real time problems

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-

Syllabus

Unit 1. Introduction to Data Structures
Introduction and Definition of Data Structure, Classification of Data, Arrays, Several types of Data Structure, Static and Dynamic Memory Allocation.
Unit 2. Arrays and Pointers.
Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays, Pointer, Pointer to Structure, various Programs for Array and Pointer.
Unit 3. Linear Data Structures
Abstract Data Type, List ADT: Singly linked lists, Doubly linked lists, Circular Linked Lists, Stack ADT implementation and applications, Queue ADT: Implementation and Application. Circular Queue, Priority Queue
Unit 4. Non-Linear Data Structures.
Properties of a binary tree, Representation of a binary tree, Operations on a Binary Tree, Binary tree – Insertion, Deletion, Traversal, Types of Binary Trees - Expression tree, Binary search tree, AVL tree, Heap
Unit 5. Graphs
Introduction to graph, Types of graphs, Graph representations -Adjacency matrix, Adjacency list. Graph traversals - Breadth First Search, Depth First Search. Shortest path algorithm - Dijkstra's algorithm

Textbooks / References:
1. E. Horowitz & Sahni, Fundamental Data Structure, Galgotia Book Source, 1983.
2. A. Tannenbaum, Data Structure Using C, Pearson Education, 2003.
3. Classic Data Structures by D. Samanta, Second Edition.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA202	OPERATING SYSTEMS	L-T-P-C: 3-0-0-3

Course Objective(s)

A successful student will be able to understand the basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Outcomes

COs	Description
CO1	Explain the basic concepts of operating system with different types of OS, services and system calls
CO2	Get knowledge of process management, Inter process communication and various CPU scheduling algorithms
CO3	Learn about deadlocks, methods of handling deadlocks and preventing deadlocks
CO4	Describe the concept of memory management -paging and segmentation.
CO5	Learn about various I/O systems and mass storage structures

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	1	-	-	-	-	-	-	-	-
CO2	2	3	2	3	-	-	1	-	-	-	-	-	-	-	-
CO3	2	3	1	3	-	-	1	-	-	-	-	-	-	-	-
CO4	2	1	2	2	-	-	1	-	-	-	-	-	-	-	-
CO5	1	2	2	2	-	-	1	-	-	-	-	-	-	-	-

Syllabus

UNIT I

Introduction to Operating Systems: Mainframe systems-Desktop systems-Multiprocessor systems- Distributed systems-Clustered systems-Real-time systems-Handheld systems.

Operating System Structures: System components-Operating System services-System calls- System Programs.

UNIT II

Process Management: Process Concept-Process Scheduling-Operations on processes-Cooperating processes-Inter Process Communication. CPU Scheduling: Basic concepts-Scheduling criteria- Scheduling Algorithms-First Come First served Scheduling, Shortest job First Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling.Process synchronisation: Background, critical section problem, semaphores, producer consumer problem, dining philosophers problem, readers and writers problem.

UNIT III

Deadlocks: System Model-Deadlock Characterization-Methods for handling Deadlocks-Deadlock Prevention-Deadlock Avoidance-Deadlock detection-Recovery from deadlock.

UNIT IV

Memory Management: Background-Swapping-Contiguous Memory allocation-Paging- Segmentation-Segmentation with Paging. Virtual Memory: Background-Demand paging-Process creation-Page replacement-Allocation of Frames-Thrashing.

UNIT V

I/O Systems: Overview, I/O Hardware

Mass storage structure- Disk structure, disk scheduling, disk management. Case study on desktop and mobile operating system

Textbooks

1. Silberschatz and Galvin, "Operating System Concepts", 10th Edition, John Wiley and Sons, 2021.

References

1. Godbole - Operating Systems - Tata McGraw Hill Publications
2. H.M Deitel - Operating Systems - Second Edition - Pearson Edition Asia
3. Andrew S. Tannenbaum, "Modern Operating Systems", 4th Edition, Pearson, 2015

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	25
End Semester Exam	50
Total Marks	100

24CSA203	COMPUTER ORGANIZATION AND ARCHITECTURE	L-T-P-C: 3-0-0-3

Course Objective(s)
- To understand the basic structure and organization of computer system, basic functions and the operations of functional units.

Course Outcomes

COs	Description
CO1	To understand the basic functional units of computer system, data representation and arithmetic operations.
CO2	To understand the concept of fetch and execution of machine instructions, addressing modes and different instruction types.
CO3	To familiarize the memory organization, types of memory and memory mapping.
CO4	To learn IO Organization and peripheral interfacing.
CO5	To understand parallel processing concepts and embedded systems.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	1	-	-	-	-	2	-	-
CO2	2	-	1	-	-	-	-	-	1	-	-	-	2	-	-
CO3	3	2	1	-	-	-	1	-	--	-		1	2	-	-
CO4	3	1	-	-	-	-	1	-	-	-	1	1	1	-	-
CO5	3	3	-	-	-	-	-	-	-	-	1	1	1	-	-

Syllabus
Unit 1:BASIC STRUCTURE OF COMPUTERS:
Basic structure of a Computer System: - Functional Units, Multiprocessors and Multicomputers concepts, Basic Arithmetic Operations: Data Representation, Fixed Point Representation. Floating – Point Representation. Integer Addition and Subtraction, Fixed and Floating-point numbers, Floating point representation, Signed numbers, Binary Arithmetic, 1's and 2's Complements Arithmetic, Multiplication of positive numbers , signed operand multiplication - Booth multiplication.
Unit 2: BASIC PROCESSING UNIT AND MACHINE INSTRUCTIONS
Fundamental concepts, Register transfers, Fetching a word from memory, Storing a word in memory, Execution of a complete instruction, Branch instructions, A Complete processor, Basic instruction types, Register Transfer Languages, Addressing modes.
Unit 3: MEMORY ORGANIZATION AND ARCHITECTURE
Memory Organization: Basic Concepts, Semiconductor RAM memories, Read-only memories, Performance Analysis of memory, Cache memory: - Types of cache memory, Mapping functions, Replacement algorithms, Virtual memory: - Address Translation, Secondary storage.
Unit 4: INPUT OUTPUT ORGANIZATION
Introduction to I/O Operations, Peripheral devices , Input/Output interfaces, Modes of transfer:- Programmed I/O, Interrupt initiated I/O, Direct Memory access.
Unit 5: PARALLEL PROCESSING AND EMBEDDED SYSTEMS
Parallel Processing – Introduction to pipelining: - Instruction pipelining and Arithmetic pipelining, Hazards: - Data hazards, Instruction hazards, Handling data hazards and instruction hazards.
Embedded Systems: - Examples of embedded systems.
Textbooks / References:
1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. M Morris Mano, Computer System Architecture (3rd Edition).
3. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
4. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc.
5. F John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHill.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	25
End Semester Exam	50
Total Marks	100

24CSA281	DATA STRUCTURES LAB	L-T-P-C: 0-0-1-1

Course Objective(s)
- To gain knowledge about the fundamental concepts of algorithms, flowcharts, and performance analysis of the algorithms.
- To comprehensively understand different types of data structures used for problem-solving.

Course Outcomes

COs	Description
CO1	Create programs to implement linear data structures like Array, Stack, Queue, Linked List, and their applications.
CO2	Create programs to implement Non-linear Data structures.
CO3	Build applications to analyze and apply appropriate data structures in real-time problem-solving

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	3	3	-

Students are advised to do LAB practice not limited to, but including the following types of problems: Write a program to

1. Implement the following array operations on one-dimensional array
   a. Insert
   b. Delete
   c. Display
   d. Search
   e. Add two arrays
2. Add and multiply two matrices
3. Implement singly linked list operations such as
   a. Create a list
   b. Display
   c. Insertion
   d. Deletion
   e. Reverse
   f. Search
   g. Split w.r.t the middle value
4. Implement doubly linked list operations such as
   a. Create a list
   b. Display
   c. Insertion
   d. Deletion
   e. Reverse
   f. Search
   g. Split w.r.t the middle value
5. Implement circular linked list operations such as
   a. Create a list
   b. Display
   c. Insertion
   d. Deletion
   e. Reverse
   f. Search
   g. Split w.r.t the middle value
6. Implement a stack using arrays and linked list
7. Convert an infix expression to postfix expression using appropriate data structure
8. Evaluate a postfix expression using appropriate data structure
9. Implement a queue using arrays and linked list
10. Implement a circular queue using arrays and linked list
11. To create a Binary Search Tree using array and linked lists and perform the following:

a. Search
b. In-order, Pre-order and Post-order traversal
c. Insertion
d. Deletion
e. Count the leaf nodes and non-leaf nodes
f. Height of the BST
12. Check a given binary tree is BST or not.
13. Implement an undirected graph and
a. Count the number of edges
b. Search
14. Implement a directed graph and
a. Count the number of edges
b. Search
15. Find the shortest path from a node to all other nodes using Dijkstra's algorithm in a graph

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

Course Objective(s)

The objective of the subject will provide basic understanding of WWW, Web Development, Client side and Server side technologies to develop and deploy Websites on Internet

Course Outcomes

COs	Description
CO1	Understand the design and develop web applications.
CO2	Understand the client and server-side scripting and their applicability.
CO3	Create scripts using JavaScript in a web page.
CO4	Integrate JavaScript in a web page.
CO5	Design forms and check for data accuracy.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	-	1	1	-	-	1	1
CO2	2	-	3	-	-	-	-	-	-	1	1	-	-	2	-
CO3	2	-	2	1	1	-	-	-	-	1	2	1	2	1	-
CO4	3	-	1	-	-	-	-	-	-	1	3	1	-	1	1
CO5	3	-	2	1	1	-	-	-	-	1	1	1	2	2	-

Syllabus

Unit-1

WEB ESSENTIALS AND STYLE SHEETS

Clients, Servers, and Communication. The Internet - Basic Internet Protocols -The World WideWeb-HTTPrequestmessage-responsemessage-WebClients-WebServers-Markup Languages: XHTML. An Introduction to HTML – History –Versions -Basic XHTML Syntax and Semantics - Fundamentals of HTML.
CSS-IntroductiontoCascadingStyleSheets–Features-CoreSyntax-StyleSheetsand HTML - Cascading and Inheritance - Text Properties – Positioning.

Unit-2

CLIENT-SIDE PROGRAMMING

Introduction to JavaScript – Functions – Objects – Arrays – Built - in Objects - JavaScript Debuggers. Browsers and the DOM - Introduction to the Document Object Model DOM HistoryandLevels-IntrinsicEventHandling-ModifyingElementStyle-TheDocumentTree
-DOMEventHandling.

Unit-3

SERVER-SIDE PROGRAMMING

Introduction to PHP - Basic Programming Concepts of PHP: Variables - Data-types - Constants - ScopeofVariables-TypeofVariables-TypeCasting–Operators-OperatorsPrecedence–References – Arrays - Control Structures: Branching -If statement - Switch statement - Looping: for Loop - while Loop-dowhileLoop-foreachLoop-Functions:UserDefinedFunctions-Built-inFunction- Functions for Variables - Script Controlling Functions - Array Functions - Date and Time Functions - Mathematical Functions -String Functions - PHP Server Variables; Working with form - Uploadingfiles to Web Server using PHP.

Unit-4 ` PHP and MySQL Basic commands with PHP examples - Connection to server - creating database - selecting a database-listingdatabase-listingtablenames-creatingatable,-insertingdata-alteringtables – queries -deleting database - deleting data and tables -PHP myadmin and database bugs.

Unit-5

 XML & WEB DEPLOYMENT

Concept of DOMAIN , Concept of Hosting ,Deployment using FTP ,PHP FRAMEWORK USING WORDPRESS

TextBooks and Reference Books:
1. WebTechnologies- ComputerSciencePerspective,JeffreyC.Jackson,PearsonEducation, 2008. on Education, Fifth Edition, 2012.
2. Internet&WorldWideWeb-HowToProgram,H.M.Deitel,P.J.Deitel,et.al,Pearson Education, Fifth Edition, 2012.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

23LSK211 **Life Skills II** **L-T-P-C: 1-0-2-2**

Pre-requisite: Willingness to learn, communication skills, basic English language skills, knowledge of high school level mathematics.

Course Objective: To help students understand the corporate culture and assist them in improving their group discussion skills, communication skills, listening skills and problem-solving skills.

Course Outcomes
CO1: Soft Skills - To improve the inter-personal skills, professional etiquette and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.
CO2: Soft Skills - To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.
CO3: Aptitude - To interpret, critically analyze and solve questions in arithmetic and algebra by employing the most suitable methods.
CO4: Aptitude - To analyze, understand and apply suitable methods to solve questions on logical reasoning.
CO5: Verbal - To be able to use vocabulary in the right context and to be competent in spotting grammatical errors and correcting them.
CO6: Verbal - To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.
Skills: Communication, etiquette and grooming, inter-personal skills, listening skills, convincing skills, problem-solving skill.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	3	3	2	3
CO2	-	-	-	-	-	-	-	2	3	3	2	3
CO3	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	3	-	3
CO6	-	-	-	-	-	-	-	-	3	3	-	3

Syllabus

Soft Skills
Professional Grooming and Practices: Basics of corporate culture, key pillars of business etiquette – online and offline: socially acceptable ways of behavior, body language, personal hygiene, professional attire and cultural adaptability and managing diversity. Handling pressure, multi-tasking. Being enterprising. Adapting to corporate life: Emotional Management (EQ), Adversity Management, Health consciousness. People skills, Critical Thinking and Problem solving.

Group Discussions: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Aptitude
Logarithms, Inequalities and Modulus: Basics

Sequence and Series: Basics, AP, GP, HP, and Special Series.

Time and Work: Basics, Pipes & Cistern, and Work Equivalence.

Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks.

Logical Reasoning II: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives, Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.

Verbal Skills
Vocabulary: Help students understand the usage of words in different contexts.
Grammar (Medium Level): Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.

Reading Comprehension (Basics): Introduce students to smart reading techniques and help them understand different tones in comprehension passages.

Reasoning: Enable students to connect words, phrases and sentences logically.

Oral Communication Skills: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.

References:
1. Adair. J., (1.986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
2. Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
3. The Hard Truth about Soft Skills, by Amazone Publication.
4. Verbal Skills Activity Book, CIR, AVVP
5. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
6. The BBC and British Council online resources
7. Owl Purdue University online teaching resources
8. www.thegrammarbook.com online teaching resources
9. www.englishpage.com online teaching resources and other useful websites
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**

24CSA211	**COMPUTER NETWORKS**	L-T-P-C: 3-0-1-4

Course Objective(s)

Build an understanding of the fundamental concepts of computer networking.

Familiarize the student with the basic taxonomy and terminology of the computer networking area.

Students will be able to gain expertise in some specific areas of networking such as the design and maintenance of individual networks. .

Course Outcomes

COs	Description
CO1	Students will be able to analyze the services of OSI reference model, TCP/IP and transmission media
CO2	To familiarize with error control, correction and error detection methods.
CO3	Understand the functions of network layer and services associated with its protocols.
CO4	Apply knowledge of the transport and application layer to design and implement network applications.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	1	-	1	1	-	-	-	-	-	-	-	-	1	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	1	1	-	1	-	-	1	-	-	-	-	-	1	-	-

Syllabus

Unit 1

Evolution of Computer Networking - Types of Networks - networks topologies - Protocols Standards, World Wide Web Network Devices-The OSI reference model- TCP/IP Reference Model. Physical Layer: transmission media- Analog Transmission- Digital transmission

Unit 2

Data Link Layer Design Issues-Services provided to the Network Layer-Framing-Error Control-Flow Control- Error Detection and Correction- Elementary Data Link Protocols- Sliding Window Protocols- Multiple Access Protocols, MAC Address.

Unit 3

Introduction to Network Layer – Services - Circuit Switching Vs Packet Switching-Packet Switched Networks-Types of Routing-routing algorithms- congestion control algorithms- Network Protocols-IP- IPV4, IPV6, Subnets, Gateways-Congestion Avoidance in Network Layer.

Unit 4

The Transport Services – Services provided to the upper layers –Elements of transport Protocols –Internet Transport Protocols- Congestion Controls in Transport Layer, Application Layer: Domain Name System, and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login.

Textbooks / References:

1. Computer Networks (Fifth Edition) – Andrew S. Tanenbaum (Prentice Hall of India)

2. Computer Networking a Top-Down Approach (Fifth Edition)-James F. Kurose-Keith W. Ross(Pearson)

3. Computer Networks - Protocols, Standards and Interfaces (Second Edition) – Uyless Black (Prentice Hall of India Pvt. Ltd.)

4. Data communication and Networking (Fourth Edition)- Behrouz A Forouzan(Tata Mcgraw Hill)

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA212	**FULL STACK FRAMEWORKS**	L-T-P-C: 3-1-0-4

Course Objective(s)

The course aims to foster proficiency in building full-stack web applications using MongoDB, Express.js, React.js, and Node.js. and also to develop scalable, efficient, and modern web applications that meet industry standards and demands.

Course Outcomes

COs	Description
CO1	Understand the fundamentals of full stack development with various frameworks.
CO2	Acquire the basic knowledge of React.js.
CO3	Realize the need of Node.js in backend development.
CO4	Understand the role of Express.js in web development
CO5	Learn the fundamentals of MongoDB and gain proficiency in performing basic CRUD operations.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	-	-	-	-	-	-	3	1	-	-
CO2	3	2	1	1	3	1	-	-	-	2	2	3	-	-	1
CO3	3	3	1	1	3	1	1	-	-	2	2	3	1	-	-
CO4	3	3	1	1	3	1	1	-	-	2	2	3	1	-	-
CO5	3	2	3	2	3	1	1	-	-	2	2	3	-	-	1

Syllabus

Unit 1: Introduction to MERN Stack Introduction to Web Development Overview of MERN Stack, Setting up Development Environment, Basics of HTML, CSS, and JavaScript Introduction to MongoDB

Unit 2: Introduction to React.js, JSX Syntax and Components, State Management with Hooks, Routing and Navigation, Handling Forms and User Input

Unit 3: Introduction to Node.js and npm, Building RESTful APIs with Express.js

CRUD Operations with MongoDB and Mongoose, Authentication and Authorization, Deployment and Hosting Options

Unit 4: Introduction to Express.js, Setting Up a Server, Routing and Middleware, Request and Response Handling, Error Handling and Debugging Techniques

Unit 5: Introduction to MongoDB, Basic CRUD Operations, Data Modeling with MongoDB, Aggregation Framework, Indexing and Performance Optimization

Textbooks:
1. "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian
2. SimonHolmes ,"Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning Publications; 1 edition (31 October 2015)

References:
1. Jeff Dickey, "Write Modern Web Apps with Mean Stack ,Peachpitpress, 2015
2. Ken Williamson, "Learning Angular JS",O′Reilly; 1 edition (24 March 2015)
   MithunSatheesh, "Web development withMongoDBand Node JS",PacktPublishing Limited; 2nd Revised edition (30 October 2015).

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA213	DATA MINING	L-T-P-C: 2-1-0-3

Course Objective(s)

The objective of data mining is to extract interesting patterns from huge repository of datasets, often using statistical and computational techniques. These insights can then be used to make informed decisions, classify, associate, cluster and predict future trends, and gain a deeper understanding of the underlying relationships within the data.

Course Outcomes

COs	Description
CO1	To identify data mining and knowledge discovery process resulting patterns with various types of attributes.
CO2	To summarize the different data pre-processing techniques before applying the data mining process .
CO3	To apply association rules on transactional database to generate frequent pattern.
CO4	To Analyse the algorithms of classification, prediction and clustering.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	2	-	1	-	-	-	1	-	-	1	-
CO3	3	3	3	3	3	-	-	-	-	-	2	-	1	-	-
CO4	3	3	3	3	3	-	-	-	-	-	2	-	1	-	-

Syllabus

Unit I

Introduction: Introduction to Data Mining-Types of Data and Patterns Mined- Technologies- Applications-Major Issues in Data Mining.

Unit II

Getting to Know about your Data-data objects and attribute types, basic statistical description of data, measuring data similarity and dissimilarity, Data Pre-processing: Cleaning– Integration–Reduction–Data Transformation

Unit III

Mining Frequent Patterns: Basic Concept – Frequent Item Set Mining Methods -Apriori and FP Growth algorithms - Mining Association Rules

Unit IV

Classification and Predication: Issues – Algorithms- Decision Tree Induction - Bayesian Classification –k Nearest Neighbor- Prediction - Accuracy- Precision and Recall

Unit 5

Clustering: Overview of Clustering – Types of Data in Cluster Analysis – K Means and K Medoid, Hierarchical Clustering Algorithms

Textbooks:

1. Jiawei Han, MichelineKamber and Jian Pei, "Data mining concepts and Techniques", Third Edition, Elsevier Publisher, 2006.

References:

2. K.P.Soman, ShyamDiwakar and V.Ajay, "Insight into data mining Theory and Practice", Prentice Hall of India, 2006.

3. William H Inmon "Building the Data Warehouse", Wiley, Fourth Edition 2005.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA214	**DESIGN AND ANALYSIS OF ALGORITHM**	L-T-P-C: 3-1-0-4

Course Objective(s)
- To learn different algorithm design techniques and design algorithms using the same.
- To analyze an algorithm and determine its time complexity.
- To learn methods to deal with intractable problems.

Course Outcomes

COs	Description
CO1	Able to estimate the asymptotic complexity of algorithms and compare various algorithms.
CO2	Able to design algorithms using an appropriate algorithm design technique and prove the correctness.
CO3	Learn various graph algorithms and their applications.
CO4	Learn about intractable problems and devise methods to tackle them.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2									2	3	
CO2	3	2	3	2	1								3	3	
CO3	3	2	3	2	1								2	1	
CO4	2	2	2	3			1						2	1	

Syllabus

Unit I Fundamentals of Algorithmic Problem Solving – Important Problem Types, Notion of Algorithmic Efficiency, Asymptotic analysis, Asymptotic notations. Analyzing recursive algorithms. Searching and Sorting algorithms – Linear search, Binary search, Bubble sort, Insertion sort.

Unit II

Divide and Conquer algorithms – Merge sort, Quicksort, Lower bound of comparison-based sorting. Greedy algorithms – Greedy strategy, Fractional knapsack. Dynamic programming – Optimality of Dynamic programming, 0/1 Knapsack.

Unit III

Graph Algorithms –Applications of BFS, Applications of DFS. Shortest path algorithms (with analysis) – SSSP: Dijkstra's algorithm. APSP: Floyd Warshall's.

Unit IV

Complexity classes –P, NP, NP-complete, NP-hard, Examples of P and NP.

Textbooks / References:

1. Analysis of Algorithms, Jeffrey J McConnel, Jones and Bartlett Publishers, Inc, 2nd Revised edition, 2 November 2007
2. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Third Edition, Pearson Education, 2012
3. Introduction to Algorithms, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, and Clifford Stein. Third Edition, Prentice-Hall of India Private Limited; 2009.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA282	**FULL STACK FRAMEWORK LAB**	L-T-P-C: 0-0-1-1

Course Objective(s)

To give hands-on experience in designing, developing, and deploying full-stack web applications using industry-standard frameworks. Through practical exercises and projects, to gain proficiency in utilizing frameworks like MERN (MongoDB, Express.js, React.js, Node.js) to create robust and scalable web solutions.

Course Outcomes

COs	Description
CO1	To demonstrate how to build dynamic and user interfaces based on components using React, an open source, front-end JavaScript library.
CO2	To enable fast and event-driven back-end development, facilitating seamless communication between the front-end and back-end components.
CO3	To enable fast and event-driven back-end development, facilitating seamless communication between the front-end and back-end components.
CO4	To demonstrate the use of MongoDB and CRUD operations

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	-	-	-	-	1	2	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	1	2-	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	1	2-	-

Syllabus

Unit 1: React.js Lab Programs

      Set up a React.js project using Create React App.

      Create functional and class-based React components for a simple UI.

      Implement state management using React's useState and useContext hooks.

      Integrate React Router for client-side routing in a React.js application.

      Fetch data from a RESTful API and display it dynamically in a React.js application

Unit 2: Node.js Lab Programs

      Create a simple HTTP server using Node.js.

      Implement basic file I/O operations (read/write) using Node.js fs module.

      Implement a program to read the query string using Node JS(Using URL Module)

      Set up routing and request handling using the built-in HTTP module in Node.js.

      Implement email service using NodeJS nodemailer service.

      Integrate third-party APIs (e.g., weather API) into a Node.js application.

Unit 3: Express.js Lab Programs

      Set up an Express.js project structure with routing.

      Create RESTful APIs for a simple to-do list application using Express.js.

      Implement middleware functions for authentication and error handling in an Express.js application.

      Integrate Express.js with MongoDB using Mongoose for CRUD operations.

Unit 4: MongoDB Lab Programs

      Install MongoDB and set up a local database server.

      Create a MongoDB database and define collections.

      Perform CRUD operations (Create, Read, Update, Delete) on MongoDB collections using the MongoDB shell.

      Connect a Node.js application to MongoDB using the official MongoDB Node.js driver.

      Implement basic data validation and schema definition using Mongoose in a Node.js application.

Textbooks:

   1. "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian

   2. SimonHolmes ,"Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning Publications; 1 edition (31 October 2015)

References:

   1. Jeff Dickey, "Write Modern Web Apps with Mean Stack ,Peachpitpress, 2015

   2. Ken Williamson, "Learning Angular JS",O'Reilly; 1 edition (24 March 2015)

3. MithunSatheesh, "Web development withMongoDBand Node JS",PacktPublishing Limited; 2nd Revised edition (30 October 2015).

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA283	INTRODUCTION TO PYTHON LAB	L-T-P-C: 0-0-1-1

Course Objective(s)
• This course provides the basics of programming using Python programming language

Course Outcomes

COs	Description
CO1	Design programs to solve problems using the Python language constructs
CO2	Develop real-time applications using advanced Python libraries.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	-	-	1	-	-	-	-	-	1	-	-
CO2	3	3	3	-	1	-	1	-	-	-	-	-	1	1	1

Syllabus

Installing Python: basic syntax, interactive shell, editing, saving, and running a script
Python variables, assignments, expressions, numerical data types and operators, writing comments in the program. Exercise on Control structures and loops in Python: if-else, for, while.

Lists, tuples, set and dictionaries: basic list operators, replacing, inserting, removing an element; searching and sorting lists; tuple creation and manipulation, creating sets and set operations, dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

Designing functions with various types of arguments. Exercise on the usage of lambda, map, filter, zip. Working with text files: Programs for manipulating files and directories, os and sys modules; Reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

Developing Python programs to implement inheritance and overloading and overriding.

Introduction to Jupyter notebook and IPython. Developing programs using Numpy, Panda and Matplotlib libraries in Jupyter notebook

Textbooks / References:
1. Wesley J. Chun, ―Core Python Applications Programming‖, 3rd Edition , Pearson Education, 2016
2. Charles Dierbach, ―Introduction to Computer Science using Python‖, Wiley, 2015 3. Jeeva Jose & P. Sojan Lal, ―Introduction to Computing and Problem Solving with PYTHON‖, Khanna Publishers, New Delhi, 2016.

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

| 23**LSK**301 | **Life Skills III** | **L-T-P-C: 1-0-2-2** |

Pre-requisite: Team Spirit, self-confidence and required knowledge, basic English language skills, knowledge of high school level mathematics.

Course Objective: To help students understand the nuances of leadership, know the importance of working in teams, face challenging situations, crack interviews, improve communication skills and problem-solving skills.

Course Outcomes
CO1: Soft Skills - To acquire the ability to work in teams, present themselves confidently and showcase their knowledge, skills, abilities, interests, practical exposure, strengths and achievements to potential recruiters through a resume, video resume, and personal interview.
CO2: Soft Skills - To have better ability to prepare for facing interviews, analyse interview questions, articulate correct responses and respond appropriately to convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.
CO3: Aptitude - To manage time while arriving at appropriate strategies to solve questions in geometry, statistics, probability and combinatorics.
CO4: Aptitude - To analyze, understand and apply suitable methods to solve questions on data analysis and data sufficiency.
CO5: Verbal - To use diction that is less verbose and more refined and to use prior knowledge of grammar to correct/improve sentences.
CO6: Verbal - To understand arguments, analyze arguments and use inductive/deductive reasoning to arrive at conclusions. To be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.
Skills: Communication, teamwork, leadership, facing interviews and problem-solving.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	3	3	-	3
CO2	-	-	-	-	-	-	-	2	3	3	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	3	-	3
CO6	-	-	-	-	-	-	-	-	3	3	-	3

Syllabus

Soft Skills
Team Work: Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration skills.
Leadership: Initiating and managing change, Internal problem solving, Evaluation and co-ordination, Growth and productivity, Importance of Professional Networking.
Facing an interview: Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing (including cover letter, digital profile and video resume), being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.

Aptitude
Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.

Permutations & Combinations: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.

Probability: Basics, Addition & Multiplication Theorems, Conditional Probability and Bayes' Theorem.

Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.

Data Interpretation: Tables, Bar Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, and other forms of data representation.

Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

Campus recruitment papers: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

Miscellaneous: Interview Puzzles, Calculation Techniques and Time Management Strategies.

Verbal Skills
Vocabulary: Create an awareness of using refined language through idioms and phrasal verbs.

Grammar (Advanced Level): Enable students to improve sentences through a clear understanding of the rules of grammar.

Reasoning Skills: Facilitate the student to tap his reasoning skills through Syllogisms, and critical reasoning arguments.

Reading Comprehension (Advanced): Enlighten students on the different strategies involved in tackling reading comprehension questions.

Public Speaking Skills: Empower students to overcome glossophobia and speak effectively and confidently before an audience.

Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style. Practice formal written communication through writing emails especially composing job application emails.

References:
1. Adair. J., (1.986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
2. Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
3. The Hard Truth about Soft Skills, by Amazone Publication.
4. Verbal Skills Activity Book, CIR, AVVP
5. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
6. The BBC and British Council online resources
7. Owl Purdue University online teaching resources
8. www.thegrammarbook.com online teaching resources
9. www.englishpage.com online teaching resources and other useful websites
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**

Course Objective(s)
- To understand the fundamentals of machine learning and its applications.
- To familiarize the machine learning models like linear and logistic regression
- To understand different classifiers and clustering algorithms
.

Course Outcomes

COs	Description
CO1	Able to understand basic concepts of machine learning and to categorize the problems as supervised/ unsupervised/ Reinforcement learning.
CO2	Select and apply supervised algorithms and analyze the models using different evaluation parameters.
CO3	To build ML models using ANN, SVM classifiers
CO4	To Apply different clustering algorithms for the unlabeled data and interpret the results.
CO5	Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2													
CO2	3	3	3		1								1	1	
CO3	3	3	3		1								1	1	
CO4	3	3	3		1								1	1	
CO5	2	2	3		1								1	1	

Syllabus
Unit 1
Introduction to ML, Goals and applications of machine learning. Types of learning: Supervised, Unsupervised, and Reinforcement. Aspects of developing a learning system: training and testing data.
Computational Learning theory- Sample complexity, ε- exhausted version space, PAC learning, agnostic learner, Vapnik–Chervonenkis (VC) dimension
Unit 2
Linear regression, variance, bias, gradient descent, R^2, Ridge and Lasso regression. Logistic regression, decision boundary, Kernel regression, Bayesian learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. KNN, Decision tree, Model evaluation: Accuracy, precision, recall, F-measure, RoC curve.
Unit 3
Artificial Neural Networks-Perceptron and backpropagation neural network, Support vector machines: multicategory generalizations, Kernels for learning non-linear functions.
Unit 4
Unsupervised learning. Clustering: Learning from unclassified data. Hierarchical Clustering. k-means- partition based clustering. Expectation maximization (EM) for soft clustering, Density based clustering
Unit 5
Model selection, Model selection criteria, Description length, Feature engineering and feature selection. PCA and LDA, Combining classifiers, Bagging, boosting, Random Forest, ADA Boost classifier. . Markov models, Hidden Markov models (HMMs), Bayesian networks, Learning Bayesian networks, Current problems in machine learning. Introduction to deep learning.
Textbooks/References

1. Kevin P. Murphey, "Machine Learning, a probabilistic perspective", The MIT Press, 2012.
2. Tom Mitchael, "Machine Learning", McGraw Hill, 1997.
3. EthemAlpaydin,"Introduction to Machine learning", PHI learning, MIT Press, 2010, 2nd   edition
4. John D. Killeher, Brian Mac, Namee, AoiFE D'Arcy, Fundamental of Machine Learning for Predictive Data Analytics, 2015 MITpress.

5. Alex Smola and SVN. Viswanathan, "Introduction to Machine Learning", Cambridge University Press, 2008.
6. ShaiShalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press,2014.
7. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
8. Duda, Richard, Peter Hart, and David Stork, "Pattern Classification" Second Edition, New York, NY: Wiley-Interscience, 2000.
9. Hastie, T., R. Tibshirani, and J. H. Friedman, "The Elements of Statistical Learning: DataMining, Inference and Prediction", New York, Springer, 2001
10. Christopher, M. Bishop. Pattern Recognition and Machine Learning, Springer-Verlag New York, 2016.
11. Jiawei Han, Micheline Kamber and Jian Pei, "Data mining concepts and Techniques", Third Edition, Elsevier Publisher, 2006

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)
- To understand the fundamentals of machine learning and its applications.
- To familiarize with the popular ML algorithms used to solve real-world problems

Course Outcomes

COs	Description
CO1	Apply preprocessing of datasets
CO2	Develop machine learning models for classification and regression
CO3	Develop ANN for prediction
CO4	Develop machine learning models for clustering data
CO5	Design and develop machine learning models for real-world data

CO-PO Mapping CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	-	-	-	-	1	-	
CO2	2	3	3	3	2	-	-	-	-	-	-	-	1	1	
CO3	2	3	3	3	2	-	-	-	-	-	-	-	1	1	
CO4	2	3	3	3	2	-	-	-	-	-	-	-	-	1	
CO5	2	3	3	3	2									1	1

Syllabus
1. Program to implement basic preprocessing of datasets
2. Program to perform dimensionality reduction
3. Program to implement:
   a. Linear regression
   b. Logistic regression
4. Programs to implement and evaluate the following classifiers:
   a. Decision tree
   b. Naive Bayes
   c. KNN
   d. SVM
   e. Random Forest
5. Program to implement ANN
6. Program to implement the following clustering methods:
   a. Kmeans
   b. Hierarchical clustering
   c. DBSCAN
   d. EM
7. Micro Project: Real-world Machine Learning Application development

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

Course Objective(s)

This course aims to equip students with the essential knowledge and practical skills to effectively use Python frameworks for web development, data analysis, machine learning, and other application domains. It will cover core framework concepts, hands-on exercises, and industry-relevant projects.

Course Outcomes

COs	Description
CO1	Understand the fundamental principles of Python frameworks and their role in modern software development.
CO2	Gain proficiency in using popular frameworks like Django, Flask, NumPy, pandas, scikit-learn, TensorFlow, and PyTorch.
CO3	Develop problem-solving and programming skills through practical exercises and projects.
CO4	Apply Python frameworks to real-world scenarios in web development, data analysis, and machine learning.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	-	-	-	-				-	-	1
CO2	3	2	1	1	3	-	-	-	-		2	1	2	-	-
CO3	3	3	1	1	3	2	1	-	-	2	2	2	1	-	1
CO4	3	2	3	2	3	2	1	-	-	2	2	2	-	-	1

Syllabus

Unit 1: Introduction to Python Frameworks- Introduction to Python programming. Understanding frameworks: purpose, benefits, and types, Overview of popular Python frameworks, Choosing the right framework for a project, Installation and setup of frameworks.

Unit 2: Web Development Frameworks- Django: MVC architecture, URL routing, views, templates, forms, models, database integration, deployment. Flask: microframework approach, routing, request handling, templating, extensions, deployment. Comparison of Django and Flask, Web security considerations.

Unit 3: Data Analysis Frameworks- NumPy: arrays, matrices, mathematical operations, data manipulation, pandas: Series, DataFrames, indexing, selection, data cleaning, aggregation, visualization

Unit 4: Machine Learning Frameworks- scikit-learn: supervised and unsupervised learning algorithms, model selection, evaluation, hyperparameter tuning. TensorFlow or PyTorch: deep learning fundamentals, neural networks, building and training models

Lab Syllabus

- Installing and setting up Python and frameworks
- Writing basic Python code using a chosen framework
- Creating simple projects to demonstrate framework usage.
- Building a basic web application with Django (e.g., blog, portfolio)
- Building a simple API with Flask (e.g., RESTful API)
- Exploring advanced features of web frameworks
- Implementing security measures in web applications
- Analysing datasets using NumPy and pandas
- Data cleaning and preprocessing techniques
- Creating data visualizations with matplotlib, seaborn, or other libraries.
- Implementing basic machine learning algorithms with scikit-learn (e.g., regression, classification)
- Building and training a simple deep learning model with TensorFlow or PyTorch (e.g., image classification)
- Evaluating model performance and addressing common challenges

Textbooks:

1. Holovaty, Adrian, and Jacob Kaplan-Moss. *The definitive guide to Django: Web development done right*. Apress, 2009.
2. Greenfeld, D. R., & Greenfeld, A. R. (2017). *Two Scoops of Django 1.11: Best Practices for Django Web Framework*. Two Scoops Press.

3. Center-Room, C. L. (2016). DATA SCIENCE FOR BUSINESS, WHAT YOU NEED TO KNOW ABOUT DATA MINING AND DATA ANALYTIC THINKING; Provost, Foster; Fawcett, Tom;© 2015. O'REILLY MEDIA. ISBN 978-1-449-36132-7. The abbreviation for this book hereafter is "DSB". THE 4TH REVOLUTION, HOW THE INFOSPHERE IS RESHAPING HUMAN REALITY; Luciano Floridi;© 2015. OXFORD UNIVERSITY PRESS. ISBN 978-0-19-960672-6.
4. Géron, A. (2022). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow*. " O'Reilly Media, Inc.".
5. Steiner, T., Mars, M., Bowie, S., & Adema, J. (2022). Part 3: Technical Workflows, Tools, and Platforms for Experimental Publishing, Interaction, and Reuse of Books. *Books Contain Multitudes: Exploring Experimental Publishing (2022 update)*.

References:
1. Grinberg, M. (2018). *Flask web development: developing web applications with python*. " O'Reilly Media, Inc.".

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

Course Objective(s)

This course is designed to quickly get a student up to speed with writing apps for Android devices. The student will learn the basics of Android platform and get to understand the application lifecycle

Course Outcomes

COs	Description
CO1	Understand Android architecture, activities and their life cycle.
CO2	To design Android/Flutter applications using UI components.
CO3	Use View Groups comprising layouts and Views in application.
CO4	To develop mobile applications with DB connections

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	1	-	-	1
CO2	3	2	3	1	2	-	-	-	-	-	-	1	2	-	-
CO3	3	2	3	1	2	-	-	-	-	-	-	2	1	-	1
CO4	3	3	3	1	2	-	-	-	-	-	-	2	-	-	1

Syllabus

UNIT - I Mobile Application Development - Mobile Applications and Device Platforms - Alternatives for Building Mobile Apps - Comparing Native vs. Hybrid Applications -The Mobile Application Development Lifecycle.

Mobile Application Services-What is Android-Android version history-Android Architecture - Obtaining the Required Tools- Android Manifest file-Launching Your First Android Application-Exploring the IDE-Debugging Your Application-Publishing Your Application –Enumerator, Android SDK

UNIT - II Understanding Activities-Linking Activities Using Intents-Fragments-Displaying Notifications, Understanding the Components of a Screen-Adapting to Display Orientation-Managing Changes to Screen Orientation- Utilizing the Action Bar

UNIT - III

Using Basic Views-Using Picker Views -Using List Views to Display Long Lists-Understanding Specialized Fragments - Using Image Views to Display Pictures -Using Menus with Views - Using Web View- Saving and Loading User Preferences - Designing User Interfaces with Layouts, Drawing and Working with Animation.

 UNIT - IV

Android Notifications – Toast, Dialogs (TimePicker, DatePicker, Progress, Alert), Notification Manager and Push Notification

Introducing SQLite - SQLiteOpenHelper and creating a database - Opening and closing a database, Working with cursors Inserts, updates, and deletes

Using Common Android APIs – Using Android Data and Storage APIs – Working with Files and Directories.

Textbooks:

Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)

References:

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA396	MINOR PROJECT-I	4 Credits

Course Objectives
- The main objective of the Project is for the students to learn and experience all the major phases and processes involved in solving real life problems.

Course Outcomes
- The major outcome of the minor project must be well-trained students. More specifically students must have acquired the following skills:

CO's	Description
CO-1	Able to practice acquired knowledge within the chosen area of technology for project development
CO-2	Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO-3	Reproduce, improve, and refine technical aspects for the projects.
CO-4	Work as an individual or in a team in development of technical projects.
CO-5	Communicate and report effectively project related activities and findings.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				1		1	1						1
CO2		1		1	1			1	1						1
CO3	1	1	1												1
CO4		1		1							1	1			1
CO5				1							1				1

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	60
End Semester Exam	40
Total Marks	100

24CSA311	**AUTOMATA THEORY AND COMPILER DESIGN**	L-T-P-C: 3-1-0-4

Course Objective(s)
- Provide an overview of computer science theoretical foundations focusing on formal languages and Automata Theory.
- Introduce the role and importance of compilers in converting computer programs into executable formats.
- Cover the essential areas of computer science required for compiler design, including logic, formalism, mathematics, data structures, algorithms, and programming.
- Outline the stages involved in the design of standard compilers, starting from front-end compilation to back-end processes. .

Course Outcomes

COs	Description
CO1	Explain kinds of finite automata and their capabilities.
CO2	Design Finite Automata for different Regular Expressions and Languages, construct context-free grammar for various languages.
CO3	Describe stages of compilation, and lexical Analysis, Compare different types of parsers (Bottom-up and Top-down) and construct a parser for a given grammar.
CO4	Analyze syntax directed translation and representations of intermediate code, describe type checking.
CO5	Illustrate code optimization and code generation techniques in the compilation

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	2	-	-	-	2	2	-	-	1
CO2	3	3	3	3	-	-	2	-	-	-	1	2	2	-	-
CO3	3	3	2	2	-	-	1	-	-	-	1	1	1	-	1
CO4	3	3	2	2	-	-	1	-	-	-	1	1	-	-	1
CO5	3	3	2	2	-	-	1	-	-	-	1	1	-	-	1

Syllabus
Unit 1
Finite Automata (FA): Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), the language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of the FA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Minimization of Deterministic Finite Automata.
Unit 2
Regular Expressions (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions-Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, Context Free Grammar (CFG): Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings.
Unit 3
Introduction To Compilers: Definition of compiler, interpreter and its differences, the phases of a compiler, role of lexical analyzer, regular expressions, finite automata, from regular expressions to finite automata. Parsing: Parsing, the role the of parser, context free grammar, derivations, parse trees, elimination of left recursion, left factoring, predictive parsers, LL(1) grammars. Bottom Up Parsing: Definition of bottom-up parsing, LR grammars, LR parsers-simple LR, canonical LR(CLR) and Look Ahead LR (LALR) parsers, error recovery in parsing, parsing ambiguous grammars.
Unit 4
Syntax Directed Translation: Syntax directed definition, construction of syntax trees, S-attributed and L-attributed definitions, translation schemes. Intermediate Code Generation: intermediate forms of source programs– abstract syntax tree, polish notation and three address code, Type Checking: Definition of type checking, type expressions, type systems.
Unit 5
Code Optimization: Organization of code optimizer, basic blocks and flow graphs, optimization of basic blocks, the principal sources of optimization, the directed acyclic graph (DAG) representation of basic block, and global data flow analysis. Code Generation: Machine dependent code generation, object code forms, the target machine, a simple code generator, register allocation and assignment, peephole optimization.

Textbooks:
1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3rdedition, Pearson Education, India.
2. Alfred V.Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Prentice Hall, Second Edition, 2006.

References:
1. Martin, John C., Introduction to Languages and the Theory of Computation, 3rd ed., Tata McGraw Hill Education Private Limited.
2. Keith Cooper and Linda Torczon, "Engineering a Compiler", Second Edition, Morgan Kauffmann, 2011.
3. Andrew W. Appel and Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
4. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)

- To provide an idea of using various process models in the software industry according to given problem statement and scenarios.
- To provide the understanding of how to decompose the given problem into Analysis, Design and Implementation phases.
- To gain the knowledge of how Testing and Maintenance processes are conducted in a software project.

Course Outcomes

COs	Description
CO1	Students will be able to decompose the given project in to various phases by making use of appropriate process model depending on the user requirements.
CO2	Students will be able perform various life cycle activities like Analysis, Design and Implementation by learning requirements and design engineering aspects.
CO3	Students will be able to perform various processes of testing used in verification and Validation phase of the product.
CO4	Students will be able to apply the knowledge, techniques, and skills in the process of developing a software product.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	1	1	1	3	3	1	-	2	1	-	-	1
CO2	-	2	3	2	2	1	3	3	2	-	1	1	2	-	-
CO3	2	3	3	3	3	3	2	-	-	-	1	1	-	-	1
CO4	3	3	3	3	3		3	-	-	-	1	1	1	-	1

Syllabus:

Unit 1

Introduction to Software Engineering: Evolution role of a software, Changing Nature of Software, Types of Software, Software Myths. Software engineering a process framework: A layered technology, Capability Maturity Model Integration (CMMI) and its types, Process assessment, Process models: The waterfall model, Incremental process models, Evolutionary process models, specialized process models: Agile Process and Unified Process.

Unit 2

Software Requirements: Functional and non-functional requirements and framing a software requirements specification document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context models, behavioral models, data models, object models, structured methods.

Unit 3

Creating a conceptual model of UML, basic structural modelling, class diagrams, use case diagrams, sequence diagrams, Activity diagrams, Swim lane diagrams, State Chart and Component diagrams. Testing Strategies: Strategic approach of software testing, test strategies for conventional software, V-Model of software testing, System testing, Black-Box and White-Box testing, the art of Debugging.

Unit 4

Software Quality Frame work for Product metrics, Metrics for Coverage: Statement Coverage, Branch Coverage & Code Coverage and Calculating Cyclomatic Complexity. Risk management: Reactive vs Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM Plan. Quality Management: Quality concepts, Software Reviews, Formal technical reviews, Software quality Assurance, Software reliability, The ISO 9000 quality standards.

Textbooks:

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Ian Sommerville: Software Engineering, 10th Edition, Pearson Education, 2016.

References:

1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India
2. Software Engineering: K.K. Aggarwal & Yogesh Singh, New Age International Publishers.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA313   **CRYPTOGRAPHY AND CYBER SECURITY**   **L-T-P-C: 3-0-0-3**

Course Objectives

The objective of this course is to teach the concepts of securing computer network protocols, based on the application of cryptography techniques.

Course Outcomes

Sl. No	Description
CO1	Provide security of the data over the network
CO2	Do research in the emerging areas of cryptography and network security.
CO3	Implement various networking protocols.
CO4	Protect any network from the threats in the world.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	-	1	-	-		-	-	-	-	1
CO2	-	2	1	1	-	-	-	-	-		-	-	2	-	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	-	-	1
CO4	1	3	3	3	1	1	1	1	1	1	1	1	1	-	1

Syllabus

Unit 1

Introduction to Cyber Security - Types of Attacks(Active/passive), Goals for Security, Security threat and vulnerability, Cyber security models (the CIA triad, the star model). Malicious Software: Viruses, Worms, Information Theft, Key loggers, Phishing, Spyware Payload Stealthing, Backdoors, Rootkits, Distributed Denial of Service Attacks.

Unit 2

Classical encryption techniques substitution ciphers and transposition ciphers, cryptanalysis, steganography, Stream and block ciphers - Modern Block Ciphers: Block ciphers principles, Shannon's theory of confusion and diffusion. Data encryption standard (DES), Strength of DES, Differential and Linear cryptanalysis, Block cipher modes of operations.

Unit 3

Public key concepts, Principles of public key crypto systems, RSA algorithm, security of RSA. Key Management and distribution. Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution.

Unit 4

Message Authentication Codes: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions, Case study on attacks. Digital Signatures. Elgamal Digital Signature Techniques, Digital signature standards (DSS)

Unit 5

Introduction to SSL. Introduction to SSL and TLS.Introduction to Cyber Crime and security: Cyber Crimes, types of Cyber Crime, hacking, attack vectors, Cross Site Scripting (XSS), XSS Consequences. Cyber Space and criminal behavior, traditional problems associated with Cyber Crime, Introduction to Incident Response, Digital Forensics

Textbooks / References:

1. William Stallings-Cryptography and Network security PHI 3rd edition 2003.

2. Dr.T.RPadmanabhan N Harini —Cryptography and Security paper back‖, Wiley India.

3. Behrouz A. Forouzan, —Cryptography and Network Security‖, Tata McGraw-Hill Publishing.

4. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.

5. Manuel Mogollon, —Cryptography and Security Services – Mechanisms and Applications‖, Cybertech Publishing.

6. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA399	MINOR PROJECT-II	4 Credits

Course Objectives

- The main objective of the Project is for the students to learn and experience all the major phases and processes involved in solving real life problems.

Course Outcomes

- The major outcome of the minor project must be well-trained students. More specifically students must have acquired the following skills:

CO's	Description
CO-1	Able to practice acquired knowledge within the chosen area of technology for project development
CO-2	Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO-3	Reproduce, improve, and refine technical aspects for the projects.
CO-4	Work as an individual or in a team in development of technical projects.
CO-5	Communicate and report effectively project related activities and findings.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				1		1	1						1
CO2		1		1	1			1	1						1
CO3	1	1	1												1
CO4		1		1							1	1			1
CO5				1							1				1

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	60
End Semester Exam	40
Total Marks	100

24CSA499	PROJECT	12 Credits

Course Objectives
- To allow students to develop their own ideas and get experienced in industrial and research projects.
- It provides an opportunity in solving a real life problem by applying the knowledge gained through various courses of study and an exposure on different phases of software /system development life cycle.

Course Outcomes
- The major outcome of the major project must be well-trained students. More specifically students must have acquired the following skills:

CO's	Description
CO-1	Able to practice acquired knowledge within the chosen area of technology for project development
CO-2	Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO-3	Reproduce, improve, and refine technical aspects for the projects.
CO-4	Work as an individual or in a team in development of technical projects.
CO-5	Communicate and report effectively project related activities and findings.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				1		1	1						1
CO2		1		1	1			1	1						1
CO3	1	1	1												1
CO4		1			1						1	1			1
CO5				1							1				1

Evaluation Criteria

Assessment	Weightage (%)
Continuous Assessment	60
End Semester Exam	40
Total Marks	100

MATHEMATICS FOR COMPUTING

24MAT135	ALGEBRA & NUMBER THEORY	L-T-P-C: 3-1-0-4

Course Objective(s)

- Understand the fundamentals of group theory, ring theory, and fields.
- Familiarize yourself with the theorems of divisibility, congruence, Fermat, Wilson, and Euler.
- Learn the concepts of vector spaces, linear transformations, eigen values, and eigen vectors.
- Learn to implement the concepts of eigen values, diagonalisation, inner product space, orthogonality, projection, and decomposition.

Course Outcomes

COs	Description
CO1	Develop the concepts of group theory, ring theory, and fields.
CO2	Analyse divisibility theory, basic properties of congruences, and different theorems on modular algorithms.
CO3	Acquire the knowledge of vector spaces and subspaces to implement linear transformation rules.
CO4	Implement diagonalisation using eigen values and vectors.
CO5	Apply the concept of inner product spaces, projection, and decomposition to determine orthogonality and reduce dimensionality.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	-	-	1	-	-	-	-
CO2	3	3	3	2	2	-	-	1	-	-	-	-
CO3	3	3	3	2	1	-	-	1	-	-	-	-
CO4	3	3	3	2	2	-	-	1	-	-	-	-
CO5	3	3	3	2	2	-	-	1	-	-	-	-

Syllabus

Unit I

Definition of Groups, Basic Examples - Symmetric Groups, Matrix Groups, Groups of Rigid Motions of a Plane, Finite Groups of Motions, Subgroups, Cyclic Group and Factor Groups; Lagrange's Theorem; Normal Subgroups; Quotients of Groups; Homomorphisms, Automorphisms; Cayley's Theorem, Permutation Groups.
Definition of Rings, Examples including Polynomial Rings, Formal Power Series Rings, Matrix Rings and Group Rings. Commutative Rings, Integral Domain, Division Ring; Fields.

Unit II

Divisibility theory and congruences: Division algorithm, Greatest Common Divisor Euclidean algorithm, Basic properties of congruences, Binary and decimal representation of integers, Linear congruences and Chinese Remainder Theorem.
Fermat's Theorem and its Generalization, Fermat's Little theorem, Wilson's theorem, Euler's phi function, Euler's theorem, Properties of phi function.

Unit III

Vector space - Vector spaces, Sub spaces, Linear independence, Basis, Dimension, Finite dimensional vector space, null and column space; Linear Transformations

Unit IV

Problems in Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections.

Unit V

Inner Products, Angle and Orthogonality in Inner Product Spaces, Length of a Vector, Schwarz Inequality, Orthogonal Vectors, Orthogonal Complement, Orthogonal Bases: Gram-Schmidt Process; Decomposition-LU-Decompositions-The Power Method- QR method- SVD- Data Compression Using Singular Value Decomposition

Textbooks:

1. I N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.
2. Gilbert Strang,' Linear Algebra and its Applications, Fourth Edition, Cengage Learning, 2014
3. Howard Anton and Chris Rorres, 'Elementary Linear Algebra', 9th Edition, Wiley, 2005.
4. David M. Burton, Elementary Number Theory (7th edition), McGraw Hill Education (India)

References:

1. John B. Fraleigh, 'A First Course in Abstract Algebra', Narosa Publishing House, 2003.
2. Joseph A. Gallian, 'Contemporary Abstract Algebra', Cengage Learning, 2013.
3. M. Artin, 'Algebra', Prentice Hall inc., 1994.
4. David C. Lay, Linear Algebra and its Applications, Pearson

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)
- Learn mathematical reasoning for predicate, quantifiers, and arguments.
- Understand the preliminary concept of counting, permutation, and combination.
- Learn different types of relations and their properties.
- Familiarize yourself with the advanced counting techniques and graph theory.

Course Outcomes

COs	Description
CO1	Develop the concepts of mathematical reasoning.
CO2	Apply basic counting techniques, permutation and combination theory.
CO3	Implement various relations and their properties.
CO4	Solve linear recurrence relations using divide and conquer algorithm and inclusion-exclusion principle.
CO5	Determine the basic characteristics of graph theory and its real-life applications.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	1	1	-	-	-	1
CO2	3	3	3	3	2	-	1	1	-	-	-	-
CO3	3	3	3	2	2	-	1	1	-	-	-	-
CO4	3	3	3	3	2	-	1	1	-	-	-	1
CO5	3	3	3	3	2	-	1	1	-	-	-	1

Syllabus
Unit 1
Logic and Mathematical Reasoning: Logic, Prepositional Equivalence, Predicate and Quantifiers, Arguments, Theorem Proving.
Unit 2
Counting - Basics of Counting, Pigeonhole Principle, Permutation and Combinations; Set theory - Basic set operations, Venn diagrams, functions
Unit 3
Relations and Their Properties - Representing Relations, Closure of Relations, Partial Ordering, Equivalence Relations and partitions
Unit 4
Advanced Counting Techniques and Relations - Recurrence Relations, Generating Functions, solving linear Recurrence Relations, Divide and Conquer algorithm, Inclusion-Exclusion
Unit 5
Graph Theory - Graphs and subgraphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm, Euler and Hamilton Graphs: Euler graphs, Euler's theorem, Hamilton cycles, Chinese-postman problem, approximate solutions of travelling salesman problem
Textbooks:
1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw- Hill Publishing Com-pany Limited, New Delhi, Sixth Edition, 2007.
2. James Strayer, Elementary Number Theory, Waveland Press, 2002.
References:
1. R.P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.
2. Thomas Koshy, "Discrete Mathematics with Applications", Academic Press, 2005.
3. Liu, "Elements of Discrete Mathematics", Tata McGraw- Hill Publishing Company Limited, 2004.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24MAT137   **FOUNDATIONS OF APPLIED MATHEMATICS – PART I**   **L-T-P-C: 3-1-0-4**

Course Objective(s)
- Solve real life problems by mathematical modeling.
- Learn different computational tools to handle data.
- Learn the basic notions of Algebra and Trigonometry and understand operations on various functions.
- Familiarize yourself with the fundamentals of Probability and Statistics.

Course Outcomes

COs	Description
CO1	Implement mathematical modeling to solve real life problems.
CO2	Develop the knowledge of several computational tools to handle data.
CO3	Develop the basic concept of variables, expressions, and equations.
CO4	Apply different types of operations on various functions.
CO5	Acquire the fundamental concepts of probability and descriptive statistics.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	1	1	-	1	-	1
CO2	3	3	3	3	3	-	1	1	-	1	-	1
CO3	3	3	3	3	2	-	-	-	-	-	-	-
CO4	3	3	3	3	2	-	-	-	-	-	-	-
CO5	3	3	3	3	2	-	-	-	-	1	-	1

Syllabus
Unit 1
Logic and Mathematical Reasoning: Logic, Prepositional Equivalence, Predicate and Quantifiers, Arguments, Theorem Proving.
Unit 2
Counting - Basics of Counting, Pigeonhole Principle, Permutation and Combinations; Set theory - Basic set operations, Venn diagrams, functions
Unit 3
Relations and Their Properties - Representing Relations, Closure of Relations, Partial Ordering, Equivalence Relations and partitions
Unit 4
Advanced Counting Techniques and Relations - Recurrence Relations, Generating Functions, solving linear Recurrence Relations, Divide and Conquer algorithm, Inclusion-Exclusion
Unit 5
Graph Theory - Graphs and subgraphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm, Euler and Hamilton Graphs: Euler graphs, Euler's theorem, Hamilton cycles, Chinese-postman problem, approximate solutions of travelling salesman problem

Textbooks:
1. Vadakkeppatt, Ajay. Course Notes- Foundations of Applied Mathematics
2. Bird, Basic Engineering Mathematics, 7th Edition, Newnes, India
3. Stewart 2015, CALCULUS: Early Transcendentals, 8th Edition, Cengage learning, India.

References:
1. Amit Saha 2015, Doing Math with python, 1st edition, No Starch Press
2. Morley 2020, Applying Math with Python, Packt Publishing
3. Gowers 2002, Mathematics: A Very Short Introduction, 1st edition, Oxford University press

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)

- Learn Single and Multivariate Calculus.
- Understand the basic concepts of Differential and Integral calculus.
- Learn the fundamentals of Differential Equation and different types of transforms.
- Familiarize yourself with the basic concept of Linear Algebra.

Course Outcomes

COs	Description
CO1	Develop the knowledge about Single and Multivariate Calculus by determining the limits and continuity of several functions.
CO2	Implement the differentiation of functions, algebra of derivatives, and chain rule.
CO3	Develop the basic concept of Integral Calculus by determining definite and indefinite integrals, integration by parts, and numerical integration.
CO4	Apply Differential Equation and various transforms to mathematical modeling.
CO5	Acquire the fundamental concept of elementary Linear Algebra.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	1	1	-	-	-	1
CO2	3	3	3	3	2	-	1	1	-	-	-	1
CO3	3	3	3	3	2	-	1	1	-	-	-	1
CO4	3	3	3	3	2	-	1	1	-	-	-	1
CO5	3	3	3	3	2	-	1	1	-	-	-	1

Syllabus

Unit 1

Introduction to Calculus: History of calculus – Overview of calculus – Single variable and multivariable calculus – Limits of functions – Continuity of functions.

Unit 2

Differential Calculus: Differentiating a function – Slopes and derivatives - Algebra of derivatives - The chain rule of differentiation - Extreme values of functions – The mean value theorem - First and second derivative tests.

Unit 3

Integral Calculus: Area under the curve – Indefinite integral - Integration by substitution – Definite integral – Fundamental theorem of calculus – Integration by parts – Numerical Integration - Applications of the definite integral in geometry, science and engineering.

Unit 4

Differential Equations: Introduction to differential equations – Mathematical modeling with differential equations – Separation of variables – First Order Differential Equations – Second Order Constant Coefficient Linear Equations – Fourier transforms - Laplace transforms – First Order Systems – Convolution.

Unit 5

Elementary Linear Algebra: Systems of linear equations – Gauss elimination – Matrix operations, including inverses – Least square problem – Determinants and their properties – Eigenvalues and eigenvectors – Matrix decompositions

Textbooks:

1. Vadakkeppatt, Ajay. Course Notes- Foundations of Applied Mathematics, 2021
2. Stewart 2015, CALCULUS: Early Transcendentals, 8th Edition, Cengage learning, India.
3. Strang 2005, Linear Algebra and its Applications, 4th Edition, Cengage Learning (RS).

References:

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. Gowers 2002, Mathematics: A Very Short Introduction, 1st edition, Oxford University press

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)

- Understand matrix operations, system of linear equations, and the solution mechanisms.
- Familiarize yourself with the basic concepts of vector spaces, subspaces, basis, and dimension.
- Apply linear transformation rules in different aspects related to kernel, range, and change of basis.
- Learn to implement the concepts of eigen values, diagonalisation, inner product space, orthogonality, projection, and decomposition.

Course Outcomes

COs	Description
CO1	Develop the concepts of system of linear equations, rank of matrix, and solution methods for a system of linear equations.
CO2	Learn vector spaces and subspaces to determine basis, dimension, and linear independency.
CO3	Implement linear transformation rules to obtain kernel and range of a transformation.
CO4	Implement diagonalisation using eigen values and vectors.
CO5	Apply the concept of inner product spaces and projection to determine orthogonality.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	1	-	-	-	-
CO2	3	3	2	2	1	-	-	1	-	-	-	-
CO3	3	3	2	2	2	-	-	1	-	-	-	-
CO4	3	3	2	2	1	-	-	1	-	-	-	-
CO5	3	3	2	2	2	-	-	1	-	-	-	-

Syllabus
Unit 1
Linear Systems and Matrix Operations - System of Linear equations, Row reduction and echelon form, Rank of a matrix by row echelon form, Gauss elimination, Inverse of a matrix by Gauss Jordan, LU decomposition
Unit 2
Vector space - Vector spaces, Sub spaces, Linear independence, Basis, Dimension, Finite dimensional vector space, null and column space
Unit 3
Linear Transformations - Linear transformation, Relation between matrices and linear transformations, Kernel and range, Change of basis, Nilpotent transformations
Unit 4
Eigen values and Eigen vectors - Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections; Similarity of linear transformations -Diagonalization and its applications.
Unit 5
Inner Product Spaces - Inner products, Orthogonality, Orthogonal complements, Orthonormality, Projection on subspace, Gram Schmidt Process, Least Square Principle, QR Decomposition
Textbooks:
1. Howard Anton and Chris Rorrs, "Elementary Linear Algebra", Ninth Edition, John Wiley & Sons, 2000.
2. D C Lay, S R Lay and JJ McDonald, Linear Algebra and its Applications, Pearson India, Fifth edition.
References:
1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. Gilbert Strang, "Linear Algebra and its Applications", Third Edition, Harcourt College Publishers, 1988.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)
- Understand the preliminary concept of operation on sets, functions, and relations.
- Understand the fundamental aspects of number theory.
- Learn different types of matrices, their properties, operations, and eigen values.
- Learn descriptive statistics and the fundamentals of probability theory.
- Familiarize yourself with the fundamentals of differential calculus.

Course Outcomes

COs	Description
CO1	Implement set theory, mathematical logic, different types of statements, functions, and relations.
CO2	Develop the concepts of number theory.
CO3	Apply various matrix operations and Caley Hamilton theorem on different types of matrices to determine the rank and eigen values.
CO4	Develop the concept of descriptive statistics and probability theory.
CO5	Develop the basic concepts of limits and derivatives.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	3	3	3	1	-	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	1	-	1
CO5	3	3	3	3	2	-	-	-	-	-	-	1

Syllabus
Unit 1
Basic concepts of set theory and operations on sets - Mathematical logic – statements – connectives - negation, conjunction, disjunction - statement formulas and truth tables - conditional and bi-conditional statements – tautology – contradiction - equivalence of formulas - duality law - Predicates and Quantifiers, Arguments - functions- relations.

Unit 2
Number theory: Divisibility- Primality Testing. GCD- Properties of the Greatest Common Divisor- Euler's Theorem - Euclid's Algorithm-Extended Euclid's Algorithm. The Fundamental Theorem of Arithmetic. The Prime Number Theorem. Modular Arithmetic- Congruence - Arithmetic with a Prime Modulus- Multiplicative Inverses- Fermat's Little Theorem- Chinese Remainder Theorem.

Unit 3
Matrix Algebra-Introduction-Types of matrices-matrix operations- transpose of a matrix -determinant of matrix - inverse of a matrix- Cramer's rule - normal form-echelon form- finding rank of a matrix -Cayley Hamilton theorem-Eigen values

Unit 4
Statistics - Introduction - Measures of central tendency – AM, Median, Mode, Measures of dispersion and its coefficients – range, QD, SD, MD.
Basics of probability theory- addition theorem, multiplication theorem, independent events, conditional probability, Baye's theorem - probability mass function - probability density function - Binomial, Poisson, and Normal distributions.

Unit 5
Differential calculus - Functions and limits - Simple Differentiation of Algebraic Functions — Evaluation of First and Second Order Derivatives – Maxima and Minima

Textbooks:

1. P.R.Vittal-Business Mathematics and Statistics,Margham Publications,Chennai.
2. Stewart 2015, CALCULUS: Early Transcendentals, 8th Edition, Cengage learning, India.

References:
1. Liu, "Elements of Discrete Mathematics", Tata McGraw- Hill Publishing Company Limited, 2004.
2. Gilbert Strang, "Linear Algebra and its Applications", Third Edition, Harcourt College Publishers, 1988.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)

• Understand the basic mechanisms of descriptive statistics
• Understand the preliminary concept of probability and different types of probability distribution
• Learn different types of two-dimensional probability distributions and correlation analysis
• Familiarize yourself with inferential statistics by studying the estimation theory and hypothesis testing

Course Outcomes

COs	Description
CO1	Implement various methods of descriptive statistics using central tendency, dispersion, skewness, kurtosis, correlation and regression analysis, and least squares.
CO2	Develop the fundamental concept of probability theory and distribution functions.
CO3	Analyze two-dimensional probability distribution theory for discrete case.
CO4	Apply the estimation theory to obtain maximum likelihood estimator, moments, and confidence interval.
CO5	Apply hypothesis testing for both large and small samples.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	-	1	1	-	-	-	1
CO2	3	2	2	3	2	-	1	1	-	-	-	1
CO3	3	2	2	3	2	-	-	1	-	-	-	-
CO4	3	2	2	3	2	-	-	1	-	-	-	-
CO5	3	2	2	3	2	-	-	1	-	1	1	1

Syllabus
Unit 1

Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Range, Inter quartile range, Standard deviation,), skewness and kurtosis, Correlation and Regression analysis, Method of least squares: fitting of straight line

Unit 2

Introduction to Probability, Probability, Conditional Probability, Multiplication and Total Probability rules, Independence, Bayes theorem, Random variables, Probability Distributions. Mathematical expectation and variance, Uniform, Binomial, Poisson, Exponential, and Normal distributions

Unit 3

Two dimensional random variables - Joint, marginal and conditional probability distributions for discrete case only, correlation analysis

Unit 4

Estimation theory - Point Estimation: criteria of point estimation, method of maximum likelihood estimation and method of moments, Interval Estimation: confidence Interval for mean of a Normal Distribution with Variance known and unknown, Confidence Interval for the two means of a Normal Distribution with Variance known and unknown.

Unit 5

Introduction to hypothesis testing, large sample tests for single mean and two means, Small sample tests for single mean and two means, paired t-test, Chi-square goodness of fit, Independence of attributes

Textbooks:

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.

References:

1. Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.
2. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)
- Understand the basic measures of central tendency and dispersion.
- Learn the fundamentals of correlation and regression analysis.
- Understand the preliminary concept of probability and different types of probability distribution.
- Familiarize yourself with different interpolation methods and various numerical techniques to find the solution of equation and simultaneous linear equations.

Course Outcomes

COs	Description
CO1	Develop the concepts of descriptive statistics by employing measures of central tendency and dispersion.
CO2	Apply the concepts of correlation and regression in various problems.
CO3	Develop the fundamental concept of probability theory and distribution functions.
CO4	Implement different interpolation methods.
CO5	Determine the solutions of an equation by bisection and Newton Raphson method and simultaneous linear equations by Gauss Elimination methods.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	1	-	-	-	-	1
CO2	3	3	3	3	2	-	1	-	-	-	-	1
CO3	3	3	3	3	2	-	1	-	-	-	-	1
CO4	3	3	3	3	2	-	1	-	-	-	-	1
CO5	3	3	3	3	2	-	1	-	-	-	-	1

Syllabus
Unit 1
Statistics-Introduction - Measures of central tendency – AM, Median, Mode, Measures of dispersion and its coefficients – range, QD, SD, MD.
Unit 2
Correlation- Karl Pearson's and Spearman's rank correlation, Regression- regression equations, regression coefficients, Method of least squares – fitting of a straight line.
Unit 3
Introduction to Probability - addition theorem, multiplication theorem, independent events, conditional probability, Baye's theorem, Probability distribution - Binomial, Poisson, Normal.
Unit 4
Interpolation- Newton's forward &backward method- Lagrange's Method.
Unit 5
Solutions of Numerical, Algebraic and transcendental methods- bisection method, Newton Raphson method, Simultaneous linear equations -Gauss elimination.
Textbooks:
1. P.R.Vittal-Business Mathematics and Statistics,Margham Publications,Chennai,
2. M.K.Venkataraman: Numerical methods in Science and Engineering-National Publishing Company,Chennai
References:
1. Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.
2. S.A. Mollah, Numerical Analysis and Computational Procedures, 5th edition, Books & Allied Ltd

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

ELECTIVES
PROFESSIONAL ELECTIVE (I, II, III) – GENERAL STREAM

24CSA331	IOT ARCHITECTURES AND PROGRAMMING	L-T-P-C: 3-0-1-4

Course Objectives

Applying emerging wired and wireless networking protocols, real-time and embedded systems design principles, and edge and cloud computing technologies to design and develop Internet of Things (IoT) applications, and evaluate its performance. Understanding the constraints, requirements, and architectures of hardware and software components for IoT systems.

Course Outcome

COs	Description
CO1	Describe the programmer's model.
CO2	Choose the appropriate protocol for communication between IoT devices
CO3	Analyze and evaluate the data received through sensors in IOT.
CO4	Determine the right sensors and communication protocols to use in a particular IoT system.
CO5	Use the hardware system for programming in IoT

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	1	
C02	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5		2	2	2	-	-	-	-	-	-	-	-	-	1	-	-

Syllabus

Unit I

Internet of Things: An Overview, Internet of Things, IoT conceptual framework, IoT architectural view, Technology behind IoT, Sources of IoT, M2M communication, Examples of IoT.

Unit II

Design Principles for Connected Devices: Introduction, IoT/M2M systems layers and designs standardization, Communication technologies, Data enrichment, Data consolidation and device management at gateway, Ease of Designing and Affordability.

Unit III

Web communication protocols for connected devices, Message communication protocols for connected devices, web connectivity for connected-devices network using gateway, Internet connectivity principles, IP addressing in IoT, Proxy authentication, Media Access control, Application Layer Protocols.

Unit IV

Data acquiring and storage, Organizing the data, Analytics, Knowledge acquiring, managing and storing processes, cloud computing paradigm for data collection storage and computing, IoT cloud based services.

Unit V

Sensor technology (Analog sensors and Digital sensors), Actuator, Sensor data communication protocols, Radio frequency identification technology, wireless sensor networks, Introduction to Arduino, Arduino IDE, Node MCU, Introduction to Raspberry Pi. Coding using Python. IoT case study: Smart city street lights control and monitoring

Textbooks / References:

1. Raj kamal, "Internet of Things architecture and design principles ", 1ed, Mc Graw Hill.
2. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg, et al. Wiley.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA332	COMPUTER VISION	L-T-P-C: 3-0-1-4
Course Description		

This course is a broad introduction to computer vision. This course includes topics like image types, their conversion, operation on images, image representation using feature extraction and video analysis

Course Objectives

- To understand image types and conversion
- To understand different operations on images
- To understand image representation and video analysis

Course Outcomes

COs	Description
CO1	Explain the fundamentals of computer vision, their applications, image types and basic operations
CO2	Develop various image processing techniques to binary images and understand different color spaces
CO3	Illustrate image representation using different feature extraction algorithms
CO4	Describe the methods used for analysis of videos

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-
CO2	2	2	2	1	1	-	1	-	-	-	-	-	-	-	-
CO3	2	2	2	2	2	-	2	-	-	-	-	-	-	-	-
CO4	2	2	2	2	2	-	2	-	-	-	-	1	-	-	-

Syllabus

Unit 1

Introduction to computer vision. Image processing v/s computer vision. Applications of computer vision. Types of images: binary, greyscale, color image. Image channels, splitting and merging channels, manipulating color pixels. Mathematical operations on images.

Unit 2

Binary Image Processing: Thresholding, Erosion and Dilation, opening and closing. Connected component analysis, contour analysis. Color spaces: RGB, HSV, CMYK, Y'CbCr, Y'UV. Image filtering, smoothing and gradient.

Unit 3

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Gabor filters, LBP, GLCM. .

Unit 4

Video Analysis: Motion Estimation using Optical Flow, Video stabilization, object tracking, Kalman filter, MeanShift and CamShift. Background Subtraction and Modeling. Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation

Textbooks / References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski
2. Computer Vision: A Modern Approach (Second Edition) by David Forsyth and Jean Ponce
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA333	COMPLEX NETWORK ANALYSIS	L-T-P-C: 3-0-1-4

Course Description

- Network science is an evolving field which focuses on the study of patterns of connection in a wide range of physical and social phenomena. The exponential increase in data sets derived from social, economic, and biological networks, along with modern computational power, has increased its relevance. The goal of this course is to provide a mathematical foundation for understanding and analyzing the structure of complex networks. The subject material is interdisciplinary, with topics of graph theory, probability theory, statistical physics, and computer science.

Course Objectives

- To understand and explain the workings of systems built upon complex networks
- To impart fundamental and advanced concepts in the areas of complex networks and network science that focus on study of the models and behavior of networked systems.

Course Outcome

COs	Description
CO1	Describe the fundamental concepts of graph theory and network mathematics along with properties.
CO2	Use various measures and metrics for analyzing networks.
CO3	Implement the concept of large-scale networks, communities and community detection algorithms in various applications.
CO4	Differentiate random graphs and models of network growth.
CO5	Explore and describe the processes taking place in Networks.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
C02	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	1	-	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	2	2	2

Syllabus

Unit I

Graphs and Networks- Review of basic graph theory, Examples of real-world networks, networks and their representation, the adjacency matrix, weighted networks, directed networks, hypergraphs, bipartite networks, trees, planar networks, degree, paths, components, independent paths, connectivity and cut sets, the graph Laplacian, random walks, Properties of Networks.

Unit II

Measures and Metrics: Degree centrality, eigenvector centrality, Katz centrality, page rank, hubs and authorities, closeness centrality, betweenness centrality, groups of vertices, transitivity, reciprocity, signed edges and structural balance, similarity, homophily and assortative mixing.

Unit III

The large-scale structure of Networks, Basic concepts of network communities, community structures, network navigation, Modularity, Girvan-Newman Algorithm, Spectral Bisection Algorithm, Radicchi Edge Clustering Algorithm, Wu-Hubermann Algorithm, Random Walk based Algorithm.

Unit IV

Generalized random graphs, Poisson random graphs- the configuration model, generating functions, power-law degree distribution, Models of Network Growth-Price model, Barabasi & Albert model, other growth models, vertex copying models, Bipartite Network.

Unit V

Processes on Networks: Percolation theory and network resilience, Epidemiological processes, Cascades and information spread, Cohesiveness, Cliques, Clans, Clubs, Plex, Equivalence of ties, Ego-centric networks, Cascade formation and information diffusion in Social media. Search on networks, exhaustive network search, guided network search, network navigation; network visualization and semantic zooming, Temporal network, Multilayer networks, Interdependent networks, Controllability of complex networks, Economic and financial network analytics.

The lab experiments/ case studies shall be implemented using any suitable tool such as Python/ R/ MATLAB

Textbooks / References:

1. M.E.J. Newman, "Networks: An Introduction", Oxford University Press, 2010
2. The structure and function of complex networks. https://epubs.siam.org/doi/10.1137/S003614450342480
3. Statistical mechanics of complex networks, Rev. Mod. Phys., 74(1), 2002.
4. Complex Graphs and Networks, by F. Chung and L. Lu
5. Dougles West, "Introduction to Graph Theory", Second Edition, PHI Learning Private Limited, 2011.
6. Guido Caldarelli, "Scale-Free Networks", Oxford University Press, 2007.
7. Alain Barrat, Marc Barthelemy and Alessandro Vespignani, "Dynamical processes on Complex networks", Cambridge University Press, 2008.
8. Reuven Cohen and Shlomo Havlin, "Complex Networks: Structure, Robustness and Function", Cambridge University Press, 2010.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA334	**CONNECTED INTERNET OF THINGS DEVICE**	L-T-P-C: 3-0-1-4

Course Objective
- To learn to specify, design and program modern connected electronic systems based on commodity smartphones and sensor networks.

Course Outcome

COs	Description
CO1	Identify the elements of IoT system
CO2	Describe IoT Protocols
CO3	Demonstrate Internet of Things architecture
CO4	Recognize the concepts of Web of Things
CO5	Identify the application areas where Internet of Things can be applied

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2												
C02	2	3	2												
CO3	3	1	2												1
CO4	2	1			1								1		1
CO5	2	3	2		1	1							1		1

Syllabus

Unit I

IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

Unit II

IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Mod bus – KNX – Zigbee– Network layer – APS layer – Security.

Unit III

IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Unit IV

WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.

Unit V

IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Textbooks / References:

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
5. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
6. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA335	IOT AND CLOUD COMPUTING	L-T-P-C: 3-0-1-4

Course Description

Cloud Computing and IoT are one of the most trending technologies in today's world. Although these are two different technologies, it is very interesting to learn about the interdependence of cloud computing and IoT. In the near future almost all devices and appliances will include IoT modules which will use sensor data collection and control/management based on Clouds.

Course Objectives

This course provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities.

This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices.

Course Outcomes

COs	Description
CO1	Describe the IoT characteristics, applications and challenges.
CO2	Describe general concepts of IoT and recognize different devices.
CO3	Determine the proper sensors and communication protocols to use in a particular IoT system.
CO4	Identify the architecture and infrastructure of cloud computing and resource management fundamentals.
CO5	Develop IoT applications and implement different solution approaches in Cloud and evaluate the security issues.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	2	-	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	3	-	3	-	-	-	-	-	-	-	3	3	3

Syllabus

Unit I

Introduction to IoT: Definition and Characteristics of IoT, IoT services and applications, IoT in Indian scenario, Challenges in IoT implementation.

Unit II

IoT architecture and design: IoT Layers and components, IoT device platforms(Arduino, Raspberry Pi, ESP8266).

Unit III

IoT Network and communication protocols – Networking architectures, Networking protocols (TCP/IP, 6LoWPAN, RPL, Thread), IoT Devices Application-Level Protocols (MQTT, CoAP, REST).

Unit IV

Cloud Computing Fundamentals, Cloud Computing Architectures, Cloud Types and Services, Virtualization and Resource Management.

Unit V

Application of IoT & Cloud IoT and cloud integration, Application development and cloud processing, Security and Privacy for IoT/Cloud Computing.

Textbooks / References:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

2. Andy King, "Programming the Internet of Things: An Introduction to Building Integrated, Device-to-Cloud IoT Solutions", 1st Edition, O'Reilly

3. Vibha Soni, "IoT for Beginners: Explore IoT Architecture, Working Principles, IoT Devices, and Various Real IoT Projects (English Edition)", 1st Edition, BPB Publications

4. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

| 24CSA336 | **SEMANTIC WEB TECHNOLOGIES** | **L-T-P-C: 3-0-1-4** |

Course Description

Semantic Web is an extension of the World Wide Web through standards by the World Wide Web Consortium (W3C). The standards promote common data formats and exchange protocols on the Web, most fundamentally the Resource Description Framework (RDF). According to the W3C, "The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries".

Course Objectives

This course will cover the core concepts of Semantic Web that promises to dramatically improve World Wide Web (WWW) and its use. It covers key technologies include explicit metadata, ontologies, logic, inferencing, and intelligent agents.

Course Outcomes

COs	Description
CO1	List the fundamental concepts, advantages, and limits of the semantic web.
CO2	Discuss the ontologies in the context of Computer Science and the semantic web.
CO3	Illustrate the relationship between Semantic Web and Web 2.0.
CO4	Demonstrate the RDF framework for Semantic Web.
CO5	Describe metadata, semantics of knowledge and resource, ontology, and their descriptions in XML-based syntax and web ontology language (OWL).

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	-	-	-			
CO2	2	1	-	-	-	-	1	-	-	-	1	-	1		
CO3	2	2	2	-	-	-	3	-	-	-	-	-	1		1
CO4	2	1	3	-	1	-	2	-	-	-	1	1			1
CO5	3	3	3	1	1	-	1	-	-	-	-	1		1	1

Syllabus

Unit I

The World Wide Web - Limitations of Today's Web – The Next Generation Web – Semantic Web - Layers - Semantic Web technologies – Semantics in Semantic Web – XML: Basics – Well-formed and valid Documents – Namespaces- XML schema – Addressing – Querying Document Object Model (DOM) – XML Applications – XML limitations.

Unit II

RDF Basic Ideas - RDF Specification – RDF Syntax: XML and Non- XML – RDF elements – RDF relationship: Reification, Container, and collaboration – RDF Schema – Editing, Parsing, and Browsing RDF/XML – Discovering Information – Querying (RQL, SPARQL).

Unit III

Web Ontology Language (OWL) – Classes, Instances and Properties in OWL - Complex Classes - Property Restrictions - Role Inclusion.

Unit IV

Ontology - Ontology Types – Logic - Description Logics - Rules - Inference and Reasoning - Ontology Engineering: Introduction – Constructing ontologies – Tools used in building and storing ontologies (Sesame, Jena, Protégé,NeOn) – Reusing ontologies – ontology reasoning.

Unit V

The web of data - Data on the web -shallow and deep web – Linkedopen data - linked data principles - Linked data design - Publishing linked data - Consuming and aggregating linked data.

Textbooks / References:

1. Paul Groth, Frank van Harmelen, Rinke Hoekstra. A Semantic Web Primer, Third Edition, MIT press; 2012.
2. Gómez-Pérez, A. Fernández-López, M. Corcho, O. Ontological Engineering. Springer Verlag; 2003.

3. Michael C. Daconta, Leo J. Obrst, Kevin T. Smith. The Semantic Web: A Guide to the Future of XML, Web Services and Knowledge Management, Fourth Edition, Willey Publishing; 2003.
4. John Davies, Rudi Studer, Paul Warren. Semantic Web Technologies: Trends and Research in Ontology-based Systems, Wiley & Sons; 2006.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA337	**COMPUTER GRAPHICS AND VISUALIZATION**	L-T-P-C: 3-0-1-4

Course Objectives

• To introduce the use of a graphics system and become familiar with building approach of graphics system components and algorithms related with them. Also covers the basic principles of 2D and 3D graphics. And an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.

Course Outcomes

COs	Description
CO1	Understand various types of video displays and colour models.
CO2	Understand and implement various drawing primitives using OPENGL
CO3	Understand fundamental concepts within computer graphics such as geometrical transformations.
CO4	Understand various 3D object representation techniques
CO5	Understand the concept of illumination models, removal of hidden surfaces and rendering.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	1	-	-	-	-	1	-	1	1	1
CO3	3	2	2	-	-	-	-	-	-	-	1	-	-	2	-
CO4	3	2	3	-	-	-	-	-	-	-	1	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	2	-

Syllabus

Unit 1

Computer Graphics Fundamentals: Overview of CG - Video Displays -Color Models- Output Primitives. Introduction to OPENGL- Points, Lines – Specifying a 2D World Coordinate Reference Frame in OpenGL- OpenGL Point Functions, Line Functions Polygon Fill Area Functions

Unit 2

Vertex Arrays - Line Drawing Algorithms - Circle Generation Algorithm Filled AreaPrimitives OpenGL fill Area Functions - Scan Line Polygon Filling Algorithms – BoundaryFill - Flood Fill Algorithms

Unit 3

Attributes of Output Primitives. Geometric Transformations: Basic 2Dtransformations-Other Transformations-Reflection and Shearing. OpenGL Geometric Transformation Functions.3D Object Representation: Fractals - Geometrical Transformation for - 3D Objects – Viewing and Clipping 2D Viewing Functions ClippingOperations.

Unit 4

Three Dimensional Viewing: Viewing Pipeline, Viewing Coordinates. Projections: Parallel Projections, Perspective Projections. OpenGL Two-Dimensional and Three-Dimensional Viewing Functions- OpenGL Animation. Visible Surface Detection and Illumination Models: Visible Surface Detection Methods – Illumination Methods and Surface Rendering – Polygon.

Unit 5

Rendering Methods: Constant Intensity Shading, Gouraud Shading, Phong Shading. OpenGL Illumination and Surface Rendering Functions, GUI – OpenGL Interactive Input Device Functions. The User Dialog –Interactive Picture Construction Techniques – Color Models - Computer Animation.

Textbooks/References:

1. Donald Hearn and Pauline Baker, ‒Computer Graphics with OpenGL ‖, Third Edition, Prentice Hall of India, 2009.

2. Roy A. Plastock and Gordon Kalley, ‒Schaum's Outline Series - Theory and Problems ofComputer Graphics‖, Second Edition, Tata McGraw-Hill, 2000.

3. Foley J.D, Van Dam A, Eiener S.K. and Hughes J.F., ‒Computer Graphics Principles andPractice‖, Second Edition, Pearson Education, 1996.

4. Rajiv Chopra , ‒Computer Graphics – A Practical Approach‖

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA338	**DEVOPS**	**L-T-P-C: 3-0-1-4**

Course Objectives
Students will learn the introduce DevOps terminology, definition & concepts. Learn about the different Version control tools like Git, Mercurial s . The concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment). Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems.

Course Outcomes

COs	Description
CO1	Understand different actions performed through Version control tools like Git.
CO2	Demonstrate the perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3	Explain the skill to perform Automated Continuous Deployment.
CO4	Demonstrate the configuration management using Ansible.
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	3	2	3			1	2			2			3
CO2	2			2	3	1		1		2	3	2			2
CO3		1	3	2	3		3			1		1			
CO4	3			2	3	1			2		2	3		2	
CO5	1	1	3	2	3		1			1		2		2	1

Syllabus
UNIT I
INTRODUCTION TO DEVOPS:-Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.
UNIT II
COMPILE AND BUILD USING MAVEN & GRADLE:-Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle
UNIT III
CONTINUOUS INTEGRATION USING JENKINS:-Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.
UNIT IV
CONFIGURATION MANAGEMENT USING ANSIBLE:-Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible
UNIT V
BUILDING DEVOPS PIPELINES USING AZURE:-Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

PRACTICAL EXERCISES:

1.Create Maven Build pipeline in Azure
2.Run regression tests using Maven Build pipeline in Azure
3.Install Jenkins in Cloud
4.Create CI pipeline using Jenkins
5.Create a CD pipeline in Jenkins and deploy in Cloud
6.Create an Ansible playbook for a simple web application infrastructure
7.Build a simple application using Gradle
8.Install Ansible and configure ansible roles and to write playbooks
Textbooks / References:

1. Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginnerto Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2. Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA339	**DIGITAL IMAGE PROCESSING**	**L-T-P-C: 3-0-1-4**

Course Description

Image processing deals with methods to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. This course provides basic knowledge about digital images, Imaging geometry, Image transforms, Image enhancement and filtering, Image restoration, Image segmentation, and morphological operations which are useful in any computer vision applications.

Course Objectives

To introduce students to the basics of digital image processing applicable to binary, gray scale and colour images.
To familiarize students to various algorithms in spatial and frequency domain relevant to image enhancement, restoration and segmentation applications.

Course Outcomes

COs	Description
CO1	Describe the fundamental concepts of digital image processing and perform basic operations on pixels.
CO2	Implementation of image transformation and image enhancement techniques in spatial and frequency domain to devise algorithms or mathematical models for real time image enhancement problems.
CO3	Implementation of various techniques used for image restoration.
CO4	Use morphological processing on images for simple image processing applications.
CO5	Implementation of segmentation algorithms on Images and analyze their performance.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1													
C02	3	2	2		1										
CO3	2	2	2		1										
CO4	2	2	1		1						1				
CO5	2	2	2		1						1				

Syllabus

Unit I

Digital Image Fundamentals: Elements of Visual Perception- Simple Image Formation Model -Image Sensing and Acquisition-Image Sampling and Quantization – Basic Relationships between Pixels - Image interpolation.

Unit II

Intensity Transformations and Filtering: Basic Intensity transformation Functions – Histogram Processing – Fundamentals of Spatial Filtering –Smoothing and Sharpening Spatial Filters. Filtering in Frequency Domain: 2D Discrete Fourier Transforms - Basics of filtering - Image Smoothing and Image Sharpening Using Frequency Domain Filters - Selective Filtering.

Unit III

Image Restoration: Noise Models – Restoration using Spatial Filters – Periodic Noise Reduction by Frequency Domain Filters.

Unit IV

Morphological Image Processing: Erosion – Dilation – Opening – Closing – Hit-or-Miss Transform - Extraction of Connected Components.

Unit V

Image Segmentation: Fundamentals – Point, Line and Edge Detection – Thresholding-Region Based Segmentation – Region Growing – Region Splitting and Merging.
Introduction to Color image processing.
The lab experiments/ Case studies shall be done using MATLAB/ Python.

Textbooks / References:

1. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 4th Edition, Pearson, 2018.
2. A K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
3. Al Bovik, The Essential Guide to Image Processing, Academic Press, 2009.
4. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine
5. Vision, Thomson Learning, 2008.
6. S Jayaraman, S Esakkirajan and T Veerakumar, Digital Image Processing, McGraw Hill
7. Education, 2009.
8. Arthur R. Weeks, Jr., "Fundamentals of Electronic Image Processing", First Edition, PHI,1996.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA340	**ADVANCED COMPUTER NETWORKS**	**L-T-P-C: 3-0-1-4**

Course Objectives

- The primary course objective is to provide the foundation of basics in computer networks in the digital era.
- Enable the student to understand the fundamental networking principles, standards, protocols and technologies.
- The course also provides insights into networking concepts in each layer of the protocol model.
- The course will enrich the students with hands on experience in configuring networking devices using Packet Tracer and analyzing the protocols using Wireshark.

Course Outcomes

COs	Description
CO1	Discuss concepts of the core network and layered approach.
CO2	Describe routed network and design Network Models using Simulation tools.
CO3	Describe application protocols and its analysis using simulation tools
CO4	Describe IP Addressing and subnetting.
CO5	Demonstrate a real time network and study and network troubleshooting commands

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C02	1	1	1	1	1	1	-	-	-	-	-	-	-	1	1
CO3	1	1	1	1	1	1	1	-	-	-	-	-	-	1	1
CO4	1	1	1	1	1	1	1	-	-	-	-	-	1	1	1
CO5	1	1	1	1	1	1	1	-	-	-	-	-	1	1	1

Syllabus

Unit I

Protocol layers -The Network Edge- The Network Core– Delay– Loss and Throughput in Packet Switched Networks

Unit II

IPV4,IPV6, Routing algorithm – Interior and Exterior routing. ICMP, Classless and Subnet Address Extensions (CIDR), Internet Multicasting. NAT Routing protocol design and architectures for RIP, OSPF, BGP, RIP.

Unit III

Application layer protocols – HTTP- DNS – PPP file sharing Introduction to Transport Layer Services - Connectionless Transport- UDP - Principles of Reliable Data Transfer- Connection Oriented Transport- TCP Traffic Control: Packet Scheduling, TCP Congestion Control, - Leaky Bucket, Token Bucket-Internet protocol

 Unit IV

Internet Layer-Class full Addressing – Classless addressing – Private Addresses – Subnets – Subnet masks –ARP – ICMP-Routing & Forwarding -

Unit V

Global Internet– RIP – OSPF – BGP – Broadcast & Multicast routing.

ifconfig, nw.js - netcat - netstat - DNS - dhcp and monitoring tool Wireshark Network simulator.

Textbooks / References:

1. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 6th Edition, Addison Wesley, 2008.

2. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", Fourth Edition, Morgan Kaufmann, 2007.

3. Richard Stevens, Bill Fenner and Andrew M. Rudoff, "UNIX Network Programming", Volume 1: "The Sockets Networking API", Third Edition, Addison Wesley, 2004.

4. Andrew S.Tanenbaum, "Computer Networks", Fifth Edition, Prentice Hall of India, 2011.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA341	ADVANCED WEB TECHNOLOGIES AND MEAN STACK	L-T-P-C: 3-0-1-4

Course Description

- This course introduces concepts, principles, and methods in current client and server-side Web technologies. Basic Web technologies such as HTML, HTTP, CSS, JavaScript etc. are a prerequisite to take this course. The focus of this course is rather on advanced topics in emerging Web technologies. These include combination of different Web technologies, Web toolkits and development environments, current backend Web frameworks (e.g. Node & Express), and frontend Web frameworks (e.g. Angular, React) and MongoDB.

Course Objectives

- To use HTML, CSS and Javascript to handle front-end operations and back-end server scripting.
- To develop SPA using Angular
- To develop fast and robust web applications using MEAN stack.

Course Outcome

COs	Description
CO1	Describe latest web application development trends in the IT industry
CO2	Equip students with principles, knowledge, and skills for the design and construction of web-enabled internet applications.
CO3	Design, Implement and deploy an in-house project using MongoDB, Express.js, Angular, and Node.js.
CO4	Recognize and explore the REST architecture.
CO5	Demonstrate the use of MongoDB and CRUD operations

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-1	2-	-
C02	2	3	3	-	-	-	-	-	-	-	-	-	-1	2-	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	-1	2-	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	-1	2-	-
CO5	2	3	3	-	-	-	-	-	-	-	-	-	-1	2-	-

Syllabus

Unit I

Basics of HTML, CSS, and JavaScript HTML, CSS, Bootstrap, JavaScript basics – Variables, functions, and scopes, Logic flow and loops, Events, and Document object model, Handling JSON data, Understanding JSON callbacks.

Unit II

Building Single Page Applications with Angular Single Page Application – Introduction, Two-way data binding(Dependency Injection), MVC in Angular, Controllers, Getting user input, Loops, Client-side routing – Accessing URL data, Various ways to provide data in Angular – Services and Factories, Working with filters, Directives and Cookies.

Unit III

Introduction to Node JS Installation, Callbacks, installing dependencies with npm, Concurrency and event loop fundamentals, Node JS callbacks, Building HTTP server, Importing and exporting modules,

Unit IV

Building REST services using Node JS REST services, Installing Express JS, Express Node project structure, Building REST services with Express framework, Routes, filters, template engines - Jade, ejs.

Unit V

MongoDB Basics and Communication with Node JS Installation, CRUD operations, Sorting, Projection, Aggregation framework, MongoDB indexes, Connecting to MongoDB with Node JS, Introduction to Mongoose, Connecting to MongoDB using mongoose, Defining mongoose schemas, CRUD operations using mongoose.

Textbooks / References:

1. Simon Holmes, "Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning Publications; 1 edition (31   October 2015)
2. Jeff Dickey, "Write Modern Web Apps with Mean Stack, Peachpit press, 2015
3. Angular: From Theory to Practice by Asim Hussain, CodeCraft 1st edition
4. Beginning Angular with Typescript, Greg Lim
5. Mithun Satheesh, "Web development with MongoDB and Node JS", Packt Publishing Limited; 2nd Revised edition (30 October 2015).

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

Course Objectives:
- To develop a comprehensive understanding of Graph Theory and Combinatorics and to apply these concepts in Computer Science

Course Outcomes:

COs	Description
CO1	To comprehend the basic idea about graphs, sub graphs, degrees, walks, paths,types of graphs, Multigraphs and Euler circuits, Hamiltonian graphs, connected graphs, Isomorphism, matrices associated with graphs, shortest path algorithm, DFS, BFS algorithms.
CO2	To understand the concept of trees and their properties, graph connectivity, minimum spanning trees and kruskal's algorithm
CO3	Understand the concept of planar graphs, Network Flows, Maximal flow and minimal cuts.
CO4	Review the basic principles of counting and the concept of permutations and combination.To Comprehend the pigeonhole principles in counting and apply the principle of inclusion and exclusions Combinations with repetition, derangements.
CO5	Understand and apply the concepts of recurrence relations, Burnside theorem, Polya's Enumeration Formula for enumeration problems and to find cycle index.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2		3	-	-	1	-	-	-	-	1
CO2	-	1		3	-	-	1	-	-	-	-	1
CO3	-	1		3	-	-	1	-	-	-	-	1
CO4	1		2	3	-	-	1	-	-	-	-	1
CO5	-			3	-	-	1	-	-	-	-	1

Syllabus

Unit I: Graphs, Sub graphs, degrees, walks, paths, Complete graph – Bipartite graph,Multigraphs and Euler circuits, Hamiltonian Graphs, connected graphs, isomorphism, matrices associated with graphs, shortest path algorithm, DFS, BFS algorithms.

Unit II: Trees and their properties,spanning trees, Directed, Trees, Binary Trees,cut-edges and cut-vertices, minimum spanning trees, Kruskal's algorithms,Graph connectivity, Vertex connectivity, Edge connectivity.

Unit III: Planar graphs, Euler's formula, Chromatic numbers and Four colour problem,Network Flows & Graphs as Models Flows, Maximal Flows and Minimal cuts, The Max-FlowMin Cut Theorem.

Unit IV: Basic counting principles, Permutation and Combinations, Multinomial Theorem, Pigeonhole principle,Inclusion and Exclusion principle(application to integer solutions)Combinations with repetition, derangements

Unit V: Combinations with repetition, Recurrence Relations ,Solving Linear Recurrence relations, Polya Counting, Burnside theorem(statement only)cycle index, Polya's counting formula.

Text Books:
1. Richard A Brnaldi, Introductory Combinatorics, Pearson Education, Inc. 5th edition, Pearson Education Asia Ltd, 2009.
2. J. A. Bondy and U. S. R. Murty, Graph Theory and Applications, Springer, 2008
3. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw Hill.

References:

1. Richard P. Stanley, Enumerative combinatorics, Volume 1, Cambridge University Press, 2000.
2. C.L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill, 2nd Edition, 2000.
3. N. Deo, Graph Theory with Applications to Engineering and Computer Science, PHI publication, 3rd edition, 2009

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA351	ADVANCED OPERATING SYSTEM	L-T-P-C: 3-0-03

Course Description

This is a graduate level course which provides a platform for students to dig deeper into the modern operating system technology, implementation techniques and research issues. The course enables the students to specialize in Operating Systems by exposing the recent developments and research in the area. This course covers broad range of topics which includes Unix architecture, design of modern operating systems, resource sharing and scheduling, software and hardware interaction, memory management, distributed and real time system behaviors etc.

Course Objectives

- Provide insights on the design principles of modern operating systems
- Understanding low level OS code and its interaction with hardware
- To gain knowledge on Distributed Operating System concepts
- To gain insights on the distributed resource management
- Create interest in students to explore more on the research aspects in the area

Course Outcomes

COs	Description
CO1	Describe the architecture and process management system calls
CO2	Discuss memory management and I/O management services of OS
CO3	Illustrate the file and process subsystem of Linux Operating System
CO4	Describe memory management of Linux
CO5	Explain features of real time operating systems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-			1
CO2	2	2		-	1	-	-	-	-	-	-	-			1
CO3	2	1		-	-	-	-	-	-	-	-	-			1
CO4	2	1	1	-	1	-	-	-	-	-	-	-			1
CO5	2	2		2	-	-		-	-	1	-				1

Syllabus

Unit I

Computer hardware review – Instruction execution cycle, Interrupts; Operating system concepts: Process abstraction, System calls for process management, Process execution mechanisms, Scheduling policies, Inter-process communication, Classic synchronization problems and their solutions, Deadlocks.

Unit II

Memory & Device Management: Address space abstraction, Address binding, swapping, Paging, Segmentation, Virtual memory, Page replacement algorithms, DMA & Cache memory; Overview of I/O Hardware; Application I/O Interface; Kernel I/O Subsystem; Transforming I/O Requests to Hardware Operations.

Unit III

Unix Internals: Architecture of Unix OS- Kernel Data structures, File subsystem and process subsystem – Process states and transitions – sleep and wakeup – buffer cache. File system – Internal representation of files – system calls for the file system. Inter-process communication –Network Communications.

Unit IV

Memory management in Unix- swapping, demand paging, a hybrid system with swapping and demand paging. I/O subsystem- driver interfaces, disk drivers, terminal drivers, streams Protection and Security Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control.

Unit V

Distributed Operating Systems – Architecture of Distributed systems, Message Passing, RPC, Distributed Shared Memory, Distributed Mutual Exclusion, Distributed Deadlock Detection, Real Time Operating Systems: Introduction to Real Time Operating Systems, Concepts of scheduling, Real Time Memory Management.

Textbooks / References:

Silberschatz, Galvin, Gagne, Operating System Concepts, Tenth Edition, John Wiley & Sons, Inc.
Distributed Operating Systems Concepts and Design – Pradeep K Sinha - Prentice-Hall India.
The Design of the Unix Operating System - Maurice J Bach – Prentice-Hall India.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Software testing course equip and help students to understand the various theoretical aspects of the program ranging from manual testing to test automation. Also, the students can understand the skills that are relevant to the industry by getting experience in the latest and advanced technology.

Course Objective

To study the underlying concepts in software testing and to examine the various software testing issues and find its solutions. Students are also made to expose to the advanced software testing topics, such as object-oriented software testing activities, methods and tools.

Course Outcomes

CO1	Introduction to different software testing techniques, process and errors handled in software projects.
CO2	Distinguish black box and white box testing techniques for functional and structural testing and testcase designing.
CO3	To understand the different testing activities and levels of testing which aims to uncover the defects in all the stages of project.
CO4	Discuss about the non-functional testing and debugging methods.
CO5	Demonstrate various issues for object-oriented testing and tools for testing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	1	1	-	-	1	2	1	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	1	-	2	1	-	-	-	-	1
CO3	2	2	2	1	-	1	2	2	-	1	-	-	1	-	1
CO4	2	2	2	1	-	1	2	-	-	1	-	1	-	1	1
CO5	2	2	2	1	-	1	2	1	2	1	1	1	-	-	1

Syllabus:

Introduction: Introduction to software testing and analysis - Purpose of Software testing – Some Dichotomies – a model for testing - Error, Fault, Failure, Incident, Test Cases, Testing Process, Limitations of Testing - No absolute proof of correctness.

Software testing Fundamentals - Specification-based testing techniques, code-based testing techniques, Model-based testing.

Blackbox box testing- Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.

Whitebox testing- Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing, Static Analysis, Dynamic Analysis. Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, Slice-based testing

Testing Activities - Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing, Regression Testing, Acceptance testing, Object Oriented Testing: Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing, Methods of test data generation and validation.

Program slicing and its application, Reliability analysis, Formal methods; verification methods; oracles. Testing Tools: Static Testing Tools, Dynamic Testing Tools, and Characteristics of Modern Tools

TEXT BOOKS/REFERENCES:

1. William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 2007.

2. CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 2000.

3. Boris Beizer, "Software Testing Techniques", Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.

4. Louise Tamres, "Software Testing", Pearson Education Asia, 2002

5. "Software Testing: A Craftsman's Approach, Second Edition," by Paul C Jorgensen, CRC Press, June 26, 2002. (required)

6. "The Art of Software Testing," 2nd ed., Glenford J. Myers, John Wiley & Sons, Inc., Hoboken, New Jersey, 2004. (optional)

7. "Lessons Learned in Software Testing: a Context-Driven Approach," CemKaner, James Bach, and Bret Pettichord, John Wiley & Sons, Inc., New York, 2002. (optional)

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA353	ENTERPRISE RESOURCE PLANNING	L-T-P-C: 3-0-0-3

Course Description
This course deals with the use of ERP to improve the productivity of your organization's processes as well as product life cycle management in a company. Adopt the necessary skills to select and implement the most suitable ERP system for your business.

Course Objectives
To facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders.

Course Outcome

Cos	Description
CO1	Demonstrate significance and principles of BE.
CO2	Use Business modelling concepts for ERP and its implementation.
CO3	Describe the concept of ERP and the competitive strategy and different ERP domains.
CO4	Examine market dynamics and competitive strategy of ERP using case studies.
CO5	Interpret ERP and client-server architecture, open-source ERP and commercial ERP.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2-	-	-	-	-	-	-	-	-	-	-	1	-	-
C02	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	1	-	-

Syllabus

Unit I
Introduction to ERP
Accommodating Variety – Integrated Management Information – Seamless Integration – Supply Chain Management – Resource Management – Integrated Data Model – Scope – Technology – Benefits of ERP.
Business Engineering and ERP
What is BE? – Significance and Principles of BE – BPR, ERP and IT – BE with IT – ERP and Management Concerns.

Unit II
Business Modelling for ERP
Building the Business Model.
ERP Implementation
Role of Consultants, Vendors and Users – Customization – Precautions – ERP: Post-implementation Options – ERP Implementation Methodology – Guidelines for ERP Implementation.

Unit III
ERP and the Competitive Advantage
ERP and the Competitive Strategy
The ERP Domain
MFG/PRO, IFS/Avalon - Industrial and Financial systems – Baan IV – SAP – SAP R/3 Applications – Example of an Indian ERP Package – The Arrival of ERP III.

Unit IV
Marketing of ERP
Market Dynamics and Competitive Strategy.
Sample Case Studies.

Unit V

Client Server and ERP Architecture

Introduction to Client Server – Advantages and Disadvantages – N tier Architecture – ERP Architecture.

http://ebuild.imtindia.com/erp_software_architecture.html

Open Technology

Background of Open Technology – Introduction – Proprietary v/s Open source – Need for Open-Source Solutions – Open-Source ERP.

http://elearning.nic.in/mdp/2-open-technology/opentechnology-mdp.pdf

Commercial ERP

Commercial ERP – Open-Source ERP v/s Commercial ERP.

http://www.erpwire.com/erp-articles/commercial-and-open-source-erp.htm.

Textbooks / References:

Enterprise Resource Planning – Concepts and Practice", Vinod Kumar Garg, N.K. Venkitakrishnan, Second Edition, Eastern Economy Edition, Prentice-Hall of India Pvt., Ltd., 2008.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA354	OPEN SOURCE SYSTEMS	L-T-P-C: 3-0-0-3

Course Description

- This course deals with how to use programming languages in open-source software systems and develop distributed software projects.

Course Objectives

- The objective of this course is to introduce students to open-source software.
- Students will study common open-source software licenses, open-source project structure, distributed software development, and current events in the open-source world.

Course Outcomes

COs	Description
CO1	Define the difference between open-source software and commercial software.
CO2	Exposed to the context and operation of Open-Source Communities and associated software projects.
CO3	Get familiar with participating in an open-source project using Git and GitHub.
CO4	Get insights into different development models and frameworks used in the open-source community.
CO5	Implementing open-source programming using Python.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	3	-	-	-	-	-	3	-	-	1		2			3
CO2	2	1	-	-	2	2		-	-		2			3	
CO3			2	3		3	3					1	1		2
CO4			3	2	2	2		3	2				2	1	
CO5		3	3								1	2			

Prerequisites
Programming Languages : Python Programming , Linux
Syllabus
Unit I
Overview of Open-Source System: Definition –The FOSS Philosophy–The Free Software Foundation –Terms and Norms in OSS Development –Open-Source Software Development Models–Licensing –BSD –Linux –Apache –Mozilla.
Unit II
Open-Source Development: Infrastructure needed for an open-source project–Software Development Lifecycle –Building a community –Joining an Existing.
Unit III
Open-Source Project –Ending an Open-Source Project –Open Source within a Company –Using Git and GitHub for Open-Source Development -FOSS Programming in python.
Unit IV
Deriving a Framework for Analyzing OSS: Zachman's Framework for IS Architecture –CATWOE and SoftSystem Method –Deriving the Analytical Framework for OSS Environment.
Unit V
Open-Source Server Applications: Infrastructure Services –Web Servers –Database Servers –Mail Servers –Open Source Desktop Applications: Graphical Desktops –Web Browsers –The Office Suite –Mail Clients –Personal Software–Case Studies on OSS.
Textbooks / References:

JosephFeller, BrianFitzgerald and EricS.Raymond,―Understanding Open Source Software Development‖,AddisonWesleyProfessional, 2000.
E-Book―ProducingOpenSourceSoftware‖whichisavailableat:https://producingoss.com/
"Code Reading: The Open-Source Perspective" by Diomidis Spinellis.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA355	**PARALLEL AND DISTRIBUTED COMPUTING**	L-T-P-C: 3-0-0-3

Course Description

This course deals with how to use programming languages in open-source software systems and develop distributed software projects

Course Objectives

- To introduce the fundamentals of parallel and distributed programming and application development in different parallel programming environments.
- To develop and execute basic parallel and distributed applications using basic programming models
- To learn tools such as CUDA for developing applications for multi-core processors

Course Outcomes

COs	Description
CO1	Describe requirements for programming parallel and distributed systems.
CO2	Discuss parallel and distributed computing techniques and methodologies.
CO3	Examine the architecture of Graphics Processing Units(GPU).
CO4	Describe the memory hierarchy and evaluate cost-performance tradeoffs.
CO5	Demonstrate the performance of parallel and distributed applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-
CO3	2	-	-	-	-	2	3	-	-	1	-	-	-	-	-
CO4	-	-	3	-	3	2	3	-	-	-	-	-	-	-	-
CO5	2	-	1	2	-	1	3	-	-	1	-	1	-	-	-

Syllabus

Unit 1

Introduction - Asynchronous and synchronous computation, Fault tolerance and recovery: basic concepts, fault models, agreement problems and its applications, commit protocols, voting protocols, check pointing and recovery, reliable communication, heterogeneity, interconnection topologies

Unit 2

load balancing, memory consistency model, memory hierarchies, Models of computation: shared memory and message passing systems.

Unit 3

GPU Programming Model, GPU Hardware and Parallel Communication, Fundamental Parallel Algorithms, Optimizing GPU Programs, Parallel Computing Patterns.

Unit 4

Multithreaded programming, parallel algorithms and architectures, parallel I/O, performance analysis, and tuning, power, programming models (data parallel, task parallel, process-centric, shared/ distributed memory)

Unit 5

Scalability and performance studies, scheduling, storage systems, synchronization.

Textbooks / References:

1. "Kai Hwang, Jack Dongarra, and Geoffrey C. Fox, "Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet (DCC)", 2012.
2. Andrew S. Tanenbaum and Maarten van Steen," Distributed Systems: Principles and Paradigms", Prentice-Hall, 2017.

3. Ajay D Kshemkalyani and Mukesh Singhal," Distributed computing: principles algorithms and systems", Cambridge University Press 2011.
4. David B. Kirk and Wen-mei W. Hwu," Programming Massively Parallel Processors: A Hands-on Approach", Elsevier Science, 2016.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA356	**SOFTWARE DEFINED NETWORKS**	L-T-P-C: 3-0-0-3

Course Objectives

This course aims to develop knowledge in networking fundamentals, gain a conceptual understanding of Software Defined Networks (SDN) and study industrial deployment use-cases of SDN.

Course Objectives

- Provide insights on the design principles of modern operating systems
- Understanding low level OS code and its interaction with hardware
- To gain knowledge on Distributed Operating System concepts
- To gain insights on the distributed resource management
- Create interest in students to explore more on the research aspects in the area

Course Outcomes

Cos	Description
CO1	Differentiate between traditional networks and software defined networks and learn the fundamentals of software defined networks.
CO2	Describe characteristics of SDN
CO3	Explain Open SDN Implementations
CO4	Use SDN in data centers
CO5	Apply SDN concepts to solve real time world problems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-			-
CO2	2	-		-	-	-	-	-	-	-	-	-			-
CO3	2	1	1		1	-	-	-	-	-		-			1
CO4	2	1	2	-	-	-	-	-	-	-	-	-			1
CO5	2	1	2	2	-	-	-	-	-	-	-	-			1

Syllabus

Unit I

Basic Packet Switching Terminology, Historical Background, The Modern Data Center, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, Open Source and Technological Shifts. Why SDN? Genesis of SDN.

Unit II

Working of SDN- Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods. Introduction to OpenFlow Specification, Improving OpenFlow Interoperability, OpenFlow Limitations, Optical Transport Protocol Extensions.

Unit III

Introduction to Open SDN and its limitations, SDN via APIs, SDN via Hypervisor Based Overlays, SDN via Opening up the Device, Introduction of SDN Controllers and its general concepts, Layer 3 Centric, Plexxi, Cisco OnePK. Introduction of Network Programmability, Management Interface, Application-Network Divide, Modern Programmatic Interfaces, I2RS, Modern Orchestration

Unit IV

SDN in the Data Center- Introduction of Data Center and its demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays and APIs, Real-World Data Center Implementations.

Unit V

Introduction SDN application and its usages, SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases – The Open Network Operating System.

Textbooks / References:

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, Second Edition, Morgan Kaufmann, 2014.
2. SDN: Software DefinedNetworks, An Authoritative Review of Network Programmability Technologies, By Thomas Nadeau, Ken Gray, Publisher: O'Reilly Media.
3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud 1st Edition, Kindle Edition, by William Stallings.
4. SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization 1st Edition, Kindle Edition, by Jim Doherty.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA357	EMBEDDED SYSTEMS	L-T-P-C: 3-0-0-3

Course Objectives
- To understand the concept of embedded system, microcontroller, different components of microcontroller and their interactions.
- To get familiarized with programming environment to develop embedded solutions
- To program ARM microcontroller to perform various tasks.
- To understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.

Course Outcome

COs	Description
CO1	Describe Embedded system fundamentals
CO2	Discuss microcontroller architecture
CO3	Describe ARM architecture
CO4	Implement ARM assembly programming.
CO5	Describe real time operating system

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C02	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	1	1	1	-	1	-	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Syllabus

Unit I

Introduction to Embedded Systems: Definition, Applications of ES, Embedded Hardware Units and Devices, Embedded Software, Design Metrics in ES, Challenges in ES Design.

Unit II

Architecture of 8051: 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts and Programming 8051.

Unit III

ARM- Embedded Processor: History, Architecture, Interrupt vector, Programming the ARM, ARM Assembly language, Instruction set, Conditional Execution, Arithmetic and Logical Compare.

Unit IV

ARM PROGRAMMING: Assembly programming, General structure of assembly language, writing programs, Branch instructions, Loading constrains, load and store instructions, Read- only and read/write Memory, Multiple Register Load and Store.

Unit V

REAL TIME OPERATING SYSTEMS: Introduction, Tasks and Task States, Tasks and Data, Reentrancy, Semaphores and Shared Data, Inter Process Communication-Message Queues, Mailboxes and Pipes.

Textbooks:

1. Raj Kamal, "Embedded Systems", 2nd edition, Tata McGraw Hill, 2009.
2. Lyla B Das, "Embedded Systems an Integrated Approach", 1st edition, Pearson, 2012.
3. David E. Simon, "An Embedded Software Primer", 1st edition, Pearson Education, 2008.

References:

1. Wayne Wolf, "Computers as Components-principles of Embedded Computer system Design", 1st edition, Elsevier, 2009.
2. Labrosse, "Embedding system building blocks", 2nd edition, CMP Publishers, 2007.

3. Kenneth J. Ayala and Thomson, "The 8051 Microcontroller", 3rd edition, Thompson Delmar, Learning, 2008.
4. Frank Vahid, Tony Givargis and John Wiley, "Embedded System Design, Microcontrollers", 3rd edition, Pearson Education, 2008.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA358	**ROBOTIC OPERATING SYSTEM**	**L-T-P-C: 3-0-0-3**

Course Description

This course gives an introduction to the Robot Operating System (ROS) including many of the available tools that are commonly used in robotics. With the help of different examples, the course should provide a good starting point for students to work with robots. They learn how to create software including simulation, to interface sensors and actuators, and to integrate control algorithms.

Course Objectives

- Introduce the basics of Robot Operating Systems and its architecture.
- Provide knowledge on the hardware interfacing aspects.
- Analyze the working of ROS in real world complex applications.

Course Outcomes

Cos	Description
CO1	Explain the Role of ROS in real time scenario and its significance.
CO2	Apply the Linux commands in ROS used in robotics.
CO3	Discuss the concepts behind navigation through file system.
CO4	Analyzing and debugging the node created using hardware for application.
CO5	Analyze the issues in hardware interfacing and implement the working of specific application hardware using Hardware with ROS.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	1	-	2		
CO2	-	3	2	-	2	-	-	-	-	1	-	-			
CO3	1	2	1	-	-	-	-	-	-	-	-	-	1	1	2
CO4	1	-	1	1	1	-	-	-	-	-	-	-			
CO5	1	-	-	-	1	-	-	-	1	-	1	-		3	

Pre-requisites:

Introduction to Linux and terminal commands

Basics of Python programming.

Syllabus

Unit 1

Introduction –The ROS Equation - History - distributions -difference from other meta-operating systems– services - ROS framework – operating system – releases. ROS Best Practices: ROS Local Setup guidelines, Using open-source packages with ROS, ROS Unit tests and ROS Bags.

Unit 2

UNIX commands - file system – redirection of input and output - File system security - Changing access rights – process commands – compiling, building and running commands – handling variables.

Unit 3

File system - packages – stacks – messages – services – catkin workspace – working with catkin workspace – working with ROS navigation and listing commands

Unit 4

Navigation through file system -Understanding of Nodes – topics – services – messages – bags – master – parameter server. Introduction to the ROS Navigation Stack, Navigation stack-creating transforms

Unit 5

Debugging of Nodes – topics – services – messages – bags – master – parameter – visualization using Gazebo – Rviz – URDF modeling – Xacro – launch files. Hardware Interface: Sensor Interfacing – Sensor Drivers for ROS – Actuator Interfacing – Motor Drivers for ROS. Case Studies: Using ROS In Real World Applications.

Textbooks / References:

1. Lentin Joseph, "Robot Operating Systems (ROS) for Absolute Beginners, Apress, 2018
2. Aaron Martinez, Enrique Fernández, "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013.
3. Reference Books: 1. Jason M O'Kane, "A Gentle Introduction to ROS", CreateSpace, 2013.
4. AnisKoubaa, "Robot Operating System (ROS) – The Complete Reference (Vol.3), Springer, 2018.
5. Kumar Bipin, "Robot Operating System Cookbook", Packt Publishing, 2018.
6. Wyatt Newman, "A Systematic Approach to learning Robot Programming with ROS", CRC Press, 2017.
7. Patrick Gabriel, "ROS by Example: A do it yourself guide to Robot Operating System", Lulu, 2012.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA359	SOFTWARE QUALITY ASSURANCE	L-T-P-C: 3-0-0-3

This course helps and throws an insight into students by making then understand that all software engineering processes, methods, activities, and work items are monitored and comply with the defined standards. The course also incorporates all software development processes starting from defining requirements to coding until release. Its prime goal is to make students aware of different quality standards and its management methods.

Objectives:
- To convey quality management processes, various activities of quality assurance, quality planning and quality control. Students understand the importance of standards in the quality management process and their impact on the final product.

Course Outcomes:

CO1	To get familiarize with quality challenges, factors and its activities in the project life cycle
CO2	Students get a full idea on the testing strategies and building a testing process.
CO3	Gets a clear idea on software quality in management and business context. Also, regarding Process and Product Quality.
CO4	Understands the ISO origins, different audit methods and quality assessment procedures.
CO5	Acquires a clear-cut idea on CMM and Process improvement models, Configuration Management and processes along with experience gaining through various case studies.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02	PS03
CO1	3	1	1	-	-	1	2	1	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	1	-	2	1	-	-	1	-	2
CO3	2	2	2	1	-	1	2	2	-	1	-	-	-	-	1
CO4	2	2	2	1	-	1	2	-	-	1	-	1	2	-	2
CO5	2	2	2	1	-	1	2	1	2	1	1	1	2	2	2

Introduction: The Software Quality Challenge - Software Quality Factors-The Components of Software Quality System-Integrating Quality Activities in the Project Life Cycle.

Software Testing: Strategies and Implementation-Building the Software Testing Process-Software Quality- Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors Quality Criteria, Relationship between Quality Factors and Criteria- Management Components: Metrics and Costs-Software Quality in the Business Context- Product Quality and Process Quality - ISO 9001:The Origins of ISO 9001- need for ISO 9001-Assessment and Audit Preparation-The Assessment Process.

Software CMM and other Process Improvement Models-Software Configuration Management-Introduction to Six Sigma - Case Studies: Indian Software Industry in Perspective.

TEXT BOOKS/ REFERENCES:
1. Daniel Galin, "Software Quality Assurance: From theory to Implementation", PearsonEducation, 2008
3. Nina Godbole, "Software Quality Assurance, Principles and Practice", NarosaPublications, 2011.
4. William Perry, "*Effective Methods of Software Testing*", Third Edition, Wiley, 2006.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA360	WEB SERVICES	L-T-P-C: 3-0-0-3

Course Description

This course deals with how students will be able to define a web service, deploy a web service within WSDL, understand the SOAP protocol, read and understand SOAP messages passed between server and client. It will also explain how to register and discover the service.

Course Objectives

- To Understand Web Services and implementation model for SOA.
- To Understand the SOA, its Principles and Benefits.
- To Understand XML concepts and paradigms needed for testing Web Services.

Course Outcomes

Cos	Description
CO1	Describe architecture of web services
CO2	Illustrate web service architecture and characteristics.
CO3	Describe the usage of SOAP for inter application communication.
CO4	Implement framework using WSDL
CO5	Describe Registering and Discovering Services

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	1	-	-
CO5	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-

Prerequisites

Programming languages

Syllabus

Unit I

Evolution and Emergence of Web Services – Evolution of distributed computing. Core distributed computing technologies – client/server, CORBA, JAVA RMI, Microsoft DCOM, Challenges in Distributed Computing, Introduction to Web Services – The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services.

Unit II

Web Service Architecture – Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services. Brief Overview of XML – XML Document structure, XML namespaces, Defining structure in XML documents, Reuse of XML schemes, Document navigation and transformation.

Unit III

SOAP: Simple Object Access Protocol, Inter-application communication and wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAP envelope, Encoding, Service Oriented Architectures, SOA revisited, Service roles in a SOA, Reliable messaging, Message Exchange Patterns, Message Exchange Formats.

Unit IV

Describing Web Services – WSDL introduction, nonfunctional service description, WSDL1.1 Vs WSDL 2.0, WSDL document, WSDL elements, WSDL binding, WSDL tools, WSDL port type, limitations of WSDL.

Unit V

Registering and Discovering Services : The role of service registries, Service discovery, Universal Description, Discovery, and Integration, UDDI Architecture, UDDI Data Model, Interfaces, UDDI Implementation.

Textbooks / References:

1. Web Services & SOA Principles and Technology, Second Edition, Michael P. Papazoglou.
2. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India
3. Thomas Erl, "Service Oriented Architecture", Concepts, Technology and Design", Prentice Hall of India, 2005.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA361	LINEAR ALGEBRA AND APPLICATIONS	L-T-P-C: 3-0-0-3

Course Objective(s)
- Open Source has acquired a prominent place in software industry.
- Having knowledge of Open Source and its related technologies is an essential for Computer Science student.

This course introduces Open Source methodologies and ecosystem to students.

Course Outcomes

COs	Description
CO1	Understand the basic concepts of vector space, subspace, basis, and dimension.
CO2	Understand the basic concepts of inner product space, norm, angle, Orthogonality, projection, and implementing the Gram-Schmidt process to obtain a least square solution.
CO3	Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, and range and apply it to change the basis and to transform the given matrix to diagonal/Jordan canonical form.
CO4	Understand the Eigen values and Eigen vectors and apply them to transformation problems.
CO5	Understand the linear transformations.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	1	1	-	2
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	-	2

Syllabus

Unit I

Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis – Dimension.

Unit II

Inner Product Spaces: Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle. QR- Decomposition.

Unit III

Linear Transformations: Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations. Symmetric and Skew Symmetric Matrices.

Unit IV

Eigen values and Eigen vectors: Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms

Unit V

,Conic Sections. ,   Similarity of linear transformations - Diagonalization and its applications

Textbooks

1. 1.Howard Anton and Chris Rorrs, "Elementary Linear Algebra", Ninth Edition, John Wiley & Sons, 2000.

References

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

2. Gilbert Strang, "Linear Algebraand its Applications", Third Edition, Harcourt College Publishers, 1988.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA362	DATABASE ADMINISTRATION	L-T-P-C: 3-0-0-3

Course Objectives

The major objective is to give the student an understanding of the concepts involved with the role of a Database Administrator.

They will achieve an understanding of the following: techniques for the allocation of the database to physical devices and directories; the creation of user authorities and controlling access to data and resources; management of data storage; analyzing database performance and implementing procedures for optimizing performance; procedures for the backup and recovery operations.

Course Outcomes

CO1	Understanding DBMS Architecture
CO2	Learn to create user accounts and manage security
CO3	Understand the Architecture of Oracle
CO4	Learn Network Administration
CO5	Understand backup and recovery methods

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	-	1	-	-	-	-	-	-	-	1	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	-	1	-	2
CO3	2	3	3	-	-	-	-	-	-	-	-	-	1	-	2
CO4	2	3	3	-	1	-	-	-	1	-	-	-	2	-	2

Syllabus

Introduction: DBMS Architecture : Introduction: DBMS Architecture and Data Independence – DBA Roles and Responsibilities. SQL * PLUS Overview: SQL plus Fundamentals, Producing more readable outputs, Accepting values at Runtime, Using iSQL *Plus. Modifying Data: Using DML, TCL- Managing Constraints -Managing Views.
User Access and Security: Creating and Modifying User Accounts, Managing User Groups with Profiles.
Oracle Overview and Architecture: Overview of Logical and Physical Storage Structures. Managing Oracle Instances. Control and Redo Log Files: Managing the Control Files. Managing Tables, Indexes and Constraints. Managing Users and Security.
Introduction to Network Administration: Network Design Considerations, Network Responsibilities for the DBA, Network Configuration, Overview of Oracle Net Features, Oracle Net Stack Architecture.
 Backup and Recovery Overview: Defining a Backup and Recovery Strategy, Testing- The Backup and Recovery Plan.
Introduction to Performance Tuning: Brief Overview of Tuning methodology, General Tuning Concepts.
Textbooks/ References
Craig S. Mullins, "Database Administration: The Complete Guide to DBA Practices andProcedures", Second Edition, Addison Wesley, 2012.
C.J. Date, "Introduction to Database Systems", Eighth Edition, Addison Wesley, 2003.
Chip Dawes, Biju Thomas, "Introduction to Oracle 9i SQL", BPB, 2002.
Bob Bryla, Biju Thomas, "Oracle 9i DBA Fundamental I", BPB, 2002.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

| 24CSA363 | **INFORMATION SCIENCE AND ETHICS** | **L-T-P-C: 3-0-0-3** |

Course Objectives

- To create an awareness on Engineering Ethics and Human Values.
- To understand Moral and Social Values and Loyalty
- To appreciate the rights of others.
- To create awareness on assessment of safety and risk.

Course Outcome

Cos	Description
CO1	Identify and analyze current ethical issues facing the information professions.
CO2	Use major and alternative traditions of ethics to engage contemporary dilemmas.
CO3	Evaluate and articulate arguments regarding professional decision making.
CO4	Interpret the professional and scholarly literature of information ethics.
CO5	Recognize the ethical challenges of contemporary information trends and extrapolate the future direction of the information ethics field.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1		2		2							1		1
C02	1	1		2		2									
CO3	1	1	3	2		2									
CO4		1	3	2		3									
CO5		1	2	2		3									

Syllabus

Unit I
Introduction to Information Ethics
Introduction: a unified model of information ethics, First stage: IE as an ethics of informational resources, Second stage: IE as an ethics of informational products, Third stage: IE as an ethics of the informational environment, Fourth stage: IE as a macro ethics. Information ethics as environmental ethics: The foundationalist problem, Classic macroethics and ICTs ethical problems, An informational model of macroethics, From computer ethics to information ethics, Information ethics as a patient-oriented and ontocentric theory, The normative aspect of information ethics: four ethical principles, Information ethics as a macroethics.
Unit II
Information ethics and the foundationalist debate: looking for the foundations of computer ethics, The 'no resolution approach': CE as not a real discipline. Distributed morality: Introduction: the basic idea of distributed morality, The old ethical scenario without distributed morality, The new ethical scenario with distributed morality, Some examples of distributed morality.
Unit III
Information business ethics: Introduction: from information ethics to business ethics, The informational analysis of business, The WHI ethical questions: what, how, and impact, The ethical business. Global information ethics: Introduction: from globalization to information ethics, Globalizing ethics, Global-communication ethics vs. global-information ethics, Global-information ethics and the problem of the lion, Global information-ethics and its advantages, The cost of a global-information ethics: postulating the ontic trust.
Unit IV
Ethics for it workers and it users, it security incidents: a major concern, implementing trustworthy computing, privacy: privacy protection and the law, intellectual property: what is intellectual property, Copyrights, Patents, Trade Secrets, Key Intellectuals property issues. In defence of information ethics: Introduction: addressing the sceptic, IE is an ethics of news, IE is too reductivist, IE fails to indicate what information constitutes an individual, IE's de-anthropocentrization of the ethical discourse is mistaken, IE's measure of intrinsic moral value is insufficiently clear and specific.

Textbooks / References:
1. Handbook of research on Machine and Deep Learning Applications for Cyber Security, Padmavathi Ganapathi and D. Shanmugapriya, IGI Global.
2. The Ethics of Information, Luciano Floridi, Oxford
3. Ethics in information technology, George W. Reynolds, 5th Editions.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA364	MASTERING 5G/6G TECHNOLOGIES	L-T-P-C: 3-0-0-3

Course Objective(s)

Develop and ability to understand wireless communication channel and channel models for the next generation wireless mobile communication. Explain transmission techniques and multiple access techniques to realize next generation communication system

Course Outcomes

COs	Description
CO1	Understand the knowledge of the current and future wireless mobile communication system.
CO2	Understand the various technologies required to realize the next generation wireless communication system.
CO3	Understand the requirements of various microwave circuits and their implementation for Wireless application requirements.
CO4	Understand and analyze wireless communication channel and channel models for the next generation wireless mobile communication
CO5	Understand and analyze transmission techniques and multiple access techniques to realize next generation communication system

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO	3	2	-	-	-	-	-	-	-	-	-	1	2	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	1	1	-	2
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	-	2

SYLLABUS

UNIT 1: Current trends and future vision in wireless communication, WCDMA, HSPA, LTE, LTE-Advanced, 4G vs. 5G, 5G and its enabling technologies, 6G vision.
(8L)

UNIT 2: Technological components for 5G & beyond-1: Massive MIMO, mm Wave Communication, CR Networks (CRN), SDR Networks (SDN), Multi RAT, HetNet, Visible Light Communication (VLC). Cooperative Cognitive Communication (CCC), Coordinated Multiple Point transmission (CoMP).
(8L)

UNIT 3: Technological components for 5G & beyond-2: Reconfigurable Antenna Design, Smart Antenna, Intelligent Reflecting Surface (IRS), Autonomous Network Configuration & Operation, Femto-cell deployment, Dynamic Adhoc Wireless Networks (DAWN), Ambient Intelligence, Cloud Radio Access Networks (CRAN), Network Function Virtualization (NFV), Support of IPv6, Flat IP Control, Multi Homing.
(8L)

UNIT 4: *Channel models for next generation wireless communication*: Wireless mobile environment and its challenges, wireless channel parameters, types of wireless mobile channel, mmWave MIMO channel model, Massive MIMO channel model, Model for Terahertz Communication, Role of machine learning in channel modelling, Deep leaning based MIMO CSI compression.
(8L)

UNIT 5: Transmission techniques and multiple access schemes for next generation wireless mobile communication system: multicarrier communications, OFDM, MIMO-OFDM, OFDMA, GFDM (Generalized Frequency division multiplexing), NOMA (Nonorthogonal multiple access), BDMA (Beam division multiple access), Vandermonde-subspace frequency division multiplexing (VFDM)
(8L)

Reference books:

1. Ramjee Prasad, "5G: 2020 and beyond" River publishers, Denmark, 2014.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA365	MOBILE COMPUTING	L-T-P-C: 3-0-0-3

Objectives:
The purpose of this course is to understand the concept of mobile computing paradigm, novel applications, limitations and also to impart knowledge on the typical mobile networking Infrastructure through a popular GSM protocol.
It also helps the students to get exposed to Ad-Hoc Networks and gain knowledge about different mobile platforms and application development.
Prerequisite:
Computer Networks
Fundamentals of Computer Communication

Course Outcomes

CO1	Infer knowledge about mobile communications and its services.
CO2	Identifying several communication access techniques.
CO3	Illustrate technical format, addressing and transmission strategies of packets
CO4	Determine the functionality of MAC, Network layer and Identifying a routing protocol for given Adhoc Networks
CO5	Perceive knowledge about TCP and failure recovery method

CO-PO MAPPING

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	-	-	-	-	-	-	3	1	-	-
C02	2	2	2	-	-	-	-	-	-	-	-	-	1	2	1
CO3	1	2	2	-	-	-	-	-	-	-	-	-	-	-	1
CO4	2	1	3	-	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	2	-	2	-	-	-

SYLLABUS
UNIT I INTRODUCTION
Introduction to Mobile Computing - Architecture of Mobile Computing - Novel Applications – Limitations.GSM - GSM System Architecture - Radio Interface – Protocols - Localization and Calling - Handover - Security - New Data Services.
 UNIT II DATA LINK LAYER
Medium Access Control Protocol - Wireless MAC Issues - Hidden and exposed terminals
- near and far terminals – SDMA – FDMA – TDMA – CDMA - Tunnelling Cellular Mobility - IPv6.
UNIT III MOBILE NETWORK LAYER
Mobile IP – Goals – Assumption - Entities and Terminology - IP Packet Delivery - Agent Advertisement and Discovery – Registration - Tunnelling and Encapsulation – Optimizations -Dynamic Host Configuration Protocol.
UNIT IV MOBILE TRANSPORT LAYER
Traditional TCP - Indirect TCP - Snooping TCP - Mobile TCP - Fast Retransmit and Fast Recovery - Transmission /Time-Out Freezing - Selective Retransmission - Transaction Oriented TCP.
UNIT V DATABASE ISSUES
Hoarding Techniques - Caching Invalidation Mechanisms - Client Server Computing with Adaptation- Power Aware and Context Aware Computing - Transactional Models - Query Processing – Recovery - and Quality of Service Issues.

TEXT BOOK
1. Jochen Schiller, "Mobile Communications", Second edition Addison-Wesley, 2008.

REFERENCES
1. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", Cambridge University Press, October 2004.
2. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden, Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", McGraw-Hill Professional, 2005.
3. Hansmann, Merk, Nickolas, Stober, "Principles of Mobile Computing", second edition, Springer, 2003.Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley DreamTech, 2003.

4. Ivan Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course objectives :
- The students once they complete their academic projects, they get awareness of acquiring the patent
- They also learn to have copyright for their innovative works.
- They also get the knowledge of plagiarism in their innovations which can be questioned legally.

Course Outcomes

Cos	Description
CO1	To understand the basic concepts of IPR operations.
CO2	To understand the Patent rights and Copyrights
CO3	To know about Trade Marks and its importance
CO4	To get an idea about Registration and Cancellation of Design
CO5	To understand the basic tenants of information technology act-2000

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	1	1	2	-	-
CO4	3	1	-	-	-	-	-	-	-	-	1	1	1	-	-
CO5	3	3	-	-	-	-	-	-	-	-	1	1	1	-	-
CAM	3	2	1	-	-	-	1	-	-	-	-	-	-	-	-

UNIT 1

INTRODUCTION TO IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights Introduction to TRIPS and WTO Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.

UNIT 2

PATENT RIGHTS AND COPY RIGHTS— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.

COPY RIGHT—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.

UNIT 3

TRADE MARKS— Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties.

UNIT 4

DESIGN- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.

UNIT 5

BASIC TENENTS OF INFORMATION TECHNOLOGY ACT-2000 – IT Act - Introduction E-Commerce and legal provisions E- Governance and legal provisions Digital signature and Electronic Signature. Cybercrimes.

TEXT BOOKS:

1. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
3. IPR by P. Narayanan 4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA367	COMPUTER LANGUAGE ENGINEERING	L-T-P-C: 3-0-0-3

Course Objectives
- To introduces students to the principles and techniques involved in the design, implementation, and analysis of programming languages.

Course Outcomes

COs	Description
CO1	Students will understand the fundamental concepts of programming languages and language design principles.
CO2	Knowledge in language Design Principles.
CO3	Students will gain knowledge for compiler construction
CO4	Ability to implement programming languages

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	3	2	1	2	3	3	1	-	-	-	-	-	-	3	3
CO3	3	1	3	3	1	1	1	-	-	-	-	-	-	3	3
CO4	3	-	2	2	3	1	1	-	-	-	-	-	-	3	3

Syllabus

Introduction to Programming Languages: Overview of programming language concepts, Evolution of programming languages, Language paradigms: imperative, functional, object-oriented, etc., Language features and characteristics.

Language Translation: Compilation vs. interpretation, Role of compiler in programming, Components of a compiler, Intermediate representations and code generation.Lexical Analysis: lexical analysis in language processing, Languages with Regular Expressions, Lexical analyser generators: Lex and Flex, Tokenization and token classification

Syntax Analysis: syntax analysis in language processing, Context-free grammars and parsing techniques, , Introduction to Shift Reduce parsing, Parse table ,Top Down parsing: LL parsing, Bottom-up parsing: LR parsing,
Semantic Analysis: Role of semantic analysis in language processing, Symbol tables and scope management, Type checking and type inference, Semantic actions and attribute grammars,
Intermediate Code Generation: Introduction to intermediate representations (IR),Three-address code and quadruples, Syntax-directed translation to intermediate code, Generation of control-flow graphs (CFGs),Intermediate Code Optimization: Common optimization techniques: constant folding, copy propagation, common subexpression elimination, Control-flow optimization: loop optimization, basic block optimization.

Textbooks / References:
Appel, Andrew, *"Modern Compiler Implementations in Java (Tiger Book)"*.
Muchnick, Steven*"Advanced Compiler Design and Implementation (Whale Book)"*.
Keith D ,"Engineering a Compiler"
Alfred V. Aho ,"Compilers: Principles, Techniques, and Tools"

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course Description

This course provides an overview of Linux system administration, covering fundamental concepts and practical skills essential for managing Linux-based systems. Also to manage the resources (system, network, users, etc.) and security of an IT infrastructure.

Course Outcomes

COs	Description
CO1	Identify the essential concepts of BASH command line
CO2	Demonstrate task scheduling and management of software packages
CO3	Experiment with Linux storage management and networking
CO4	Practice Linux User and group management and file system permissions
CO5	Illustrate the concepts of shell programming for system administration

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-
C02	1	1	-	1	1	2	-	-	-	-	-	-	-	1	-
CO3	1	1	-	1	2	2	-	-	-	-	-	-	-	1	1
CO4	1	1	-	1	2	-	-	-	-	-	-	-	-	1	1

Syllabus

UNIT 1

Introduction to Linux: Open-Source Linux, Origins of Linux, Distributions, Duties of Linux System Administrator. Command Line: Working with the Bash Shell, Useful Bash Key Sequences, Working with Bash History, Performing Basic File System Management Tasks, Working with Directories, Piping and Redirection, Finding Files.

UNIT 2

System Administration Tasks: Performing Job Management Tasks, System and Process Monitoring and Management, Managing Processes with ps, Sending Signals to Processes with the kill Command, Using top to Show Current System Activity, Managing Process Niceness, Scheduling Jobs, Mounting Devices, Setting Up System Logging, Setting Up Rsyslog, Common Log Files, Setting Up Log rotate. Managing Software: Understanding RPM, Understanding Meta Package Handlers, Creating Your Own Repositories, Managing Repositories, Installing Software, Querying Software

UNIT 3

Configuring and Managing Storage: Understanding Partitions and Logical Volumes, Creating Partitions, File Systems Overview, Creating File Systems, Mounting File Systems Automatically Through fstab.

Connecting to the Network: Understanding NetworkManager, Working with Services and Runlevels, Configuring the Network with NetworkManager, Working with system-config-network, NetworkManager Configuration Files, Network Service Scripts, Networking from the Command Line, Troubleshooting Networking, Setting Up IPv6, Configuring SSH, Enabling the SSH Server, Using the SSH Client, Using PuTTY on Windows Machines, Configuring Key- Based SSH Authentication, Using Graphical Applications with SSH, Using SSH Port Forwarding, Configuring VNC Server Access

UNIT 4

Working with Users, Groups, and Permissions: Managing Users and Groups, Commands for User Management, Managing Passwords, Modifying and Deleting User Accounts, Configuration Files, Creating Groups, Using Graphical Tools for User, and Group Management, Using External Authentication Sources, the Authentication Process, sssd, nsswitch, Pluggable Authentication Modules, Managing Permissions, the Role of Ownership, Basic Permissions: Read, Write, and Execute, Advanced Permissions, Working with Access Control Lists, Setting Default Permissions with umask, Working with Attributes

UNIT 5

Introducing Bash Shell Scripting: Introduction, Elements of a Good Shell Script, Executing the Script, Working with Variables and Input, Understanding Variables, Variables, Subshells, and Sourcing, Working with Script Arguments, Asking for Input, Using Command Substitution, Substitution Operators, Changing Variable Content with Pattern Matching, Performing Calculations, Using Control Structures, Using if...then...else, Using case, Using while, Using until, Using for, Configuring booting with GRUB.

TEXTBOOKS/ REFERENCE BOOKS

1. Practical Linux System Administration: A Guide to Installation, Configuration, and Management (Grayscale Indian Edition) Kenneth Hess (Author)

2. Collings T, "Red Hat Linux Networking & System Administration", 2nd Edition, English- Paperback, Wiley India Pvt. Ltd

3. Jang," Rhcsa/Rhce Practice Exam (Ex200 and Ex300) (English)" - 1st Edition, Paperback, McGraw Hill Education (India) Pvt Ltd

4. Et Al, "Red Hat Linux System Admn. Unleashed (English)", 1st Edition - Paperback, Techmedia

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA370	NON-RELATIONAL DATABASES	L-T-P-C: 3-0-0-3

CourseObjective(s)

- Gain a foundational understanding of Exploratory Data Analysis (EDA) concepts.
- Learn how to import and manipulate data using Python libraries (e.g., Pandas, NumPy).
- Perform data cleaning and pre-processing techniques.
- Create informative data visualizations using Python libraries (e.g., Matplotlib, Seaborn).
- Summarize and describe data using statistical methods.

CourseOutcomes

COs	Description
CO1	Students will have a neat comprehension of how NoSQL databases differ from relational databases from a practical perspective.
CO2	Students will be able to master the basics concepts of designing NoSQL database management system.
CO3	Students will be familiar with selecting a particular NoSQL database for specific use cases.
CO4	Students will be able to apply all types of NoSQL database to implement based on business requirements.

CO-POMapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	1	-	-	-	-
CO2	2	1	1	1	-	-	-	2	-	-	-	-
CO3	1	2	2	1	-	-	-	-	-	-	-	-
CO4	2	1	1	2	-	-	-	-	-	-	-	-

Syllabus

Unit 1
Database Management System – introduction, history of database, management systems characteristics of dbms, definition, objectives, merits and demerits, entity relationship model, concurrency control. Data Models – definition, designing databases, hierarchical data model, network data model.

Unit 2
RDBMS – relational data model, techniques & components of relational data model, definition of relational terms, features, 12 rules for a fully RDBMS.

Unit 3
NOSQL Systems-Introduction to NoSQL, Disadvantages of NoSQL technology, NOSQL Systems, weakness of RDBMS, Key-value database-Key values database, more elements of key values database, Properties of Key-value store.

Unit 4
Columnar Databases - Characteristics of a columnar database. Document databases with MongoDB - Implement a document database with Mongo DB. Graph Databases - Graph databases, properties of graph model, graph traversal problems and adjacency matrix.
Textbooks:

1. Advanced Data Management: For SQL, NoSQL, Cloud and Distributed Databases By Lena Wiese
2. Getting Started with Nosql by Gaurav Vaish.

EvaluationPattern

Assessment	Weightage(%)
Midterm	20
ContinuousAssessment (including lab)	50
EndSemesterExam	30
TotalMarks	100

24CSA371	**SOFT COMPUTING**	**L-T-P-C: 3-0-0-3**

CourseObjective(s)

Identify the characteristics of Soft computing systems and explore various applications of Soft computing techniques

Investigate applications of Neural Networks including Associative Memory, Adaptive Resonance theory, and Self Organizing Maps.

Analyse applications of Fuzzy Logic in decision-making, control systems, and classification.

Explore applications of hybrid Soft computing techniques and Analyse the convergence of GA and its multi-level optimization capabilities.

CourseOutcomes

COs	Description
CO1	Demonstrate an understanding of the characteristics of Soft computing systems and their advantages over traditional computing paradigms.
CO2	Use Neural Networks for various domains such as pattern recognition, associative memory, and optimization, and evaluate their performance.
CO3	Optimize Fuzzy Logic-based systems for improved performance in different application domains.
CO4	Critically evaluate hybrid Soft computing approaches and Genetic Algorithms to solve real-world optimization problems

CO-POMapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	1	-	-	2
CO4	3	3	3	2	2	-	-	-	1	-	-	2

Syllabus

Unit 1

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of soft computing techniques.

What is Neural Network, Learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Backpropagation (BP)Networks, Backpropagation Learning, to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

Unit 2

Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule-based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

Unit 3

Hybrid Soft Computing Techniques and Applications: Neuro-fuzzy hybrid systems, Genetic neuro hybrid systems, Genetic fuzzy hybrid and fuzzy genetic hybrid systems, simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing-based hybrid fuzzy controllers.

Unit 4

Genetic Algorithm: -History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bitwise operation in GA, Multi-level Optimization.

Textbooks:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI

2. S.N.Sivanandam and S.N.Deepa, ―Principles of Soft Computing‖, Wiley India Pvt Ltd, 2011.

3. References:

4. J.S.R.Jang, C.T.Sun, and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.

5. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, International Editions, Electrical Engineering Series, Singapore.

6. Stamatios V. Kartalopoulos "Understanding Neural Networks and Fuzzy Logic Basic Concepts & Applications", IEEE Press, PHI, New Delhi.

7. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y.

EvaluationPattern

Assessment	Weightage(%)
Midterm	20
ContinuousAssessment (including lab)	50
EndSemesterExam	30
TotalMarks	100

DATASCIENCE STREAM
PROFESSIONAL ELECTIVE (I, II, III)

24CSA431	INTRODUCTION TO BUSINESS ANALYTICS AND VISUALIZATION	L-T-P-C: 3-0-1-4

Course Objectives

- The course presents an applied approach to data mining concepts and methods, using Python software for illustration.
- Students will learn how to implement a variety of popular data mining algorithms to tackle business problems and opportunities.
- It covers both statistical and machine learning algorithms for prediction, classification, visualization, dimension reduction, recommender systems, clustering, text mining and network analysis.

Course Outcome

COs	Description
CO1	Understand the fundamentals of business intelligence, analytics, and data science.
CO2	Apply feature extraction techniques and design a solution for a classification problem employing Regression, NB Classifier and Decision trees and its variants
CO3	Understand the basic concepts of data warehousing and use of data mining techniques for business analytics
CO4	Use real life data for effective decision making using statistical models
CO5	Apply knowledge of text representation for extraction and display of information

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	-	-	1
C02	2	3	3	-	-	-	-	-	-	-	-	-	-	-	1
CO3	2	1	-	-	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	3	1	2	-	-	-	-	-	-	-	3	-	1
CO5	1	3											2		

Syllabus

Introduction to Business Intelligence- Definition, Need, and Evolution of Business Intelligence System and its components. Introduction to Business Analytics- Definition- Levels of Analytics – Descriptive, Predictive and Prescriptive Analytics- Application of business analytics in industries- case studies. Statistical Modelling for Business Analytics- Descriptive Statistics- Measures of Central Tendency and Dispersion- Quartiles and inter-quartile range.

Introduction to Data Mining - Overview of Data Mining Process, steps in data mining - Power and Over fitting - Building a Predictive Model - Data Exploration and Dimension Reduction - Data Visualization - Dimension Reduction - Correlation Analysis - Reducing the Number of Categories in Categorical Variables - Converting a Categorical Variable to a Numerical Variable -Principal Components Analysis - Performance Evaluation - Evaluating Predictive Performance - Judging Classifier Performance.

Prediction and Classification Methods - Multiple Linear Regression - Explanatory vs. Predictive Modeling - Estimating the Regression Equation and Prediction - The k-NN Classifier (Categorical Outcome) - The Naive Bayes Classifier - Classification and Regression Trees - Evaluating the Performance of a Classification Tree - Avoiding Overfitting - Logistic Regression - Neural Nets - Fitting a Network to Data - Discriminant Analysis - Classification Performance of Discriminant Analysis - Combining Methods: Ensembles and Uplift Modeling - Association Rules and Collaborative Filtering - Cluster Analysis - Measuring Distance - Hierarchical (Agglomerative) Clustering - The k-Means Algorithm.

Forecasting Time Series - Descriptive vs. Predictive Modeling. Popular Forecasting Methods in Business - Regression-Based Forecasting - A Model with Trend - A Model with Seasonality - A Model with Trend and Seasonality - Autocorrelation and

ARIMA Models - Directed vs. Undirected Networks - Visualizing and Analyzing Networks - Using Network Metrics in Prediction and Classification -Text Mining - The Tabular Representation of Text: Term-Document Matrix and "Bag-of-Words" - Bag-of-Words vs. Meaning Extraction at Document Level - Preprocessing the Text - Implementing Data Mining Methods- Case Studies.

Textbooks / References:

1. VanderPlas J. Python data science handbook: essential tools for working with data. " O'Reilly Media, Inc."; 2016. McKinney W. Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc."; 2012
2. R. N. Prasad and S. Acharya, "Fundamentals of Business Analytics", Wiley, 2nd Edition,2016
3. J. R. Evans, "Business Analytics", Pearson, 3rd Edition, 2019.
   a. Maheshwari, "Data *Analytics", McGraw Hill Education, 1st Edition, 2017*

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA432	DATA MODELLING AND VISUALIZATION	L-T-P-C : 3-0-1-4

Course Objectives
- To understanding the concepts of data analysis aided by the strategies of data visualization and data modelling.
- To familiarize with the tools of R programming for data analysis and acquire competence in problem-solving and decision-making
- To learn and implement various data modelling algorithms

Course Outcome

COs	Description
CO1	Understanding data and its processing using python.
CO2	Apply and visualize data modelling using R.
CO3	Apply data visualization using Tableau.
CO4	Understand and visualize data modelling using different types of data sources using various techniques.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	1	-	-	-	-	-	1	-	1
C02	-	1	1	1	-	-	-	-	-	-	-	-	1	-	1
CO3	-	1	1	-	1	-	-	-	-	-	-	-	-	-	1
CO4	1	1	1	-	1	-	1	-	-	-	-	-	-	-	1

Syllabus

Unit I

Data-Analytic Thinking: Knowing your data, Data pre-processing, Story telling with data. Data Visualization using Python: Introduction to Python programming, Visualization using python, Transformation using python, exploratory data analysis.

Unit II

Data Visualization using R: Introduction to R programming, Visualization using R, Transformation using R, exploratory data analysis. Data Modeling: Linear regression, Logistic regression, K-nearest neighbours, K-means clustering, Performance measure, Implementation of some modelling algorithms using python.

Unit III

Data Visualization using Tableau: Introduction to Tableau, data import and management, data type and operations, Different types of data visualizations, dashboards, storytelling, Understanding of the concepts of dynamic/interactive data visualization and report generation.

Unit IV

Data Modeling from Different Data Sources for Visualization: Understanding structured, unstructured and semi-structured data sources, Data modelling and creating visualization charts/dashboards from structured data like databases (SQL and NoSQL), Data modelling and creating visualization charts/dashboards from semi-structured data like CSV files, XML, JSON and others, Data modelling and creating visualization charts/dashboards from live streaming data.

Textbooks / References:
1. Data Analysis And Visualization Using Python: Analyze Data To Create Visualizations For Bi Systems by Embarak, Apress.
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data mining concepts and Techniques", Third Edition, Elsevier Publisher, 2006.
3. K.P.Soman, Shyam Diwakar and V.Ajay, "Insight into data mining Theory and Practice", Prentice Hall of India, 2006.
4. Data Science with R: A Step by Step Guide with Visual Illustrations & Examples, Andrew Oleksy.
5. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
6. R Programming for Data Science, Roger D. Peng, Lean Publishing, 2015.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA433	**EXPLORATORY DATA ANALYSIS**	**L-T-P-C: 3-0-1-4**

Course Description

This course covers the essential exploratory techniques for summarizing data. These techniques are typically applied before formal modelling commences and can help inform the development of more complex statistical models. Exploratory techniques are also important for sharpening potential hypotheses about the world that can be addressed by the data.

Course Objectives

- To understand the problems of working with real-time data sets
- To learn how to work with python programming tools and algorithms.
- To explore how to use data visualization.

Course Outcomes

Cos	Description
CO1	Use python/R libraries for exploratory computing and explore data wrangling technique
CO2	Explore and solve problems on various supervised and unsupervised learning algorithms
CO3	Examine Cumulative Distribution functions and Probability Density functions
CO4	Conceive and apply the knowledge on data aggregation and group operations

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	1	-	2	1	-	-	1	1			1
CO2	2	2	2	-	3	-	1	1	-	-	1	-			1
CO3	3	2	2	2	3	-	1	1	-	-	1	1			1
CO4	3	2	2	2	3	-	1	1	-	-	-	-		1	1

Syllabus

Unit I

Introduction to exploratory data analysis and what it is used for – Introduction to machine learning – about the dataset, data Preprocessing techniques, Data wrangling: Join, combine and reshape, numerical summarization, visualization – statistical learning and model selection, Prediction accuracy, cross-validation.

Unit II

Supervised Learning algorithms – Classification, Forecasting, prediction and regression, Linear Models, SVM, K-nn, Decision tree classifier, Artificial neural networks, Ensemble methods, Deep neural networks. Unsupervised learning algorithms: K-means, association rule mining, reinforcement learning, Instance-based learning.

Unit III

Cumulative Distribution functions: Percentiles, CDF's, Percentile based statistics, Modeling Distributions: Exponential Distributions, Normal distributions, Normal probability plot, long normal distributions, Descriptive statistics– location, spread, Probability Density functions: PDFs, Kernel density estimation, Distribution framework, Skewness, Relationship between variables: Correlation, covariance, Pearson's correlation, Non-linear relationship, Estimation: Sampling distribution, sampling Bias, Exponential distributions, Hypothesis testing, Regression.

Unit IV

Data aggregation and group operations – group by Mechanics, Data aggregation, group-wise operations and transformations, Pivot tables and cross-validation. Time series: Date Ranges, frequencies and shifting, Time zone handling, Period arithmetic, Resampling and frequency conversion and moving window function.

Textbooks / References:

Practical machine learning for data analysis using python, Abdulhamit Subasi, Elsevier Publication

Think Stats exploratory data analysis, Allen B. Downey, 2nd edition

Python for data analysis, Oreily, Wes McKinney.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

BIG DATA ANALYTICS AND VISUALIZATION **L-T-P-C : 3-0-1-4**

Course Objectives

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSQL, and Map-Reduce.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems for decision support.

Course Outcome

COs	Description
CO1	Understand the basic concepts in Big Data Analytics and gain the ability to choose the right solution for a task involving big data, including databases, architectures and cloud services.
CO2	Understand the different methods to analyze and visualize the big data
CO3	Develop the skillset to build effective solutions for Big Data issues using Hadoop and its Eco-System.
CO4	Get insights into different data visualization techniques and standard tools.
CO5	Understanding of real life issues faced by different organizations and its effective solutions through case studies.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	1	-	1
C02	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1
CO3	1	1	1	1	1	-	1	-	-	-	-	-	-	-	1
CO4	-	-	-	-	1	-	1	-	-	-	-	-	-	-	1
CO5	1	1	-	1	-	-	-	-	-	1	-	-	1	-	1

Syllabus

Unit I

Introduction to Big Data, Types of Digital Data, Characteristics of Big Data, Evolution of Big Data, Definition of Big Data, Data Appliance, Challenges with Big Data, Big data sources, Best practices in Big Data Analytics, Introduction to Data Modelling

Unit II

Introduction to elementary data analysis: Measures of center: Mean, Median, Mode, Variance, Standard deviation, Range, Normal Distribution :Center, Spread, Skewed Left, Skewed Right, Outlier, Correlation Patterns, Magnitude and Direction in relationship, Introduction to Bayesian Model

Unit III

History of Visualization, Goals of Visualization, Types of Data Visualization: Scientific Visualization, Information Visualization, Visual Analytics, Impact of visualization, Big Data Visualization Tools: Tableau, Google Chart

Unit IV

Introduction to Big Data Processing and Apache Hadoop, Installation and Configuration of Hadoop in Ubuntu, HDFS Concepts, Map Reduce Framework, Anatomy of a Map Reduce Job Run, Job Scheduling, Shuffle and Sort, Task Execution

Unit V

Introduction to Hadoop Eco System, Apache Hive, Apache Mahout, Apache Pig, Case studies:
Analyzing big data with twitter, Big data for Ecommerce, Big data for blogs

Textbooks:

1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics", Wiley, 2015
2. Frank J Ohlhorst, "Big Data and Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012
3. Tom White, " Hadoop: The Definitive Guide" Third Edition, O'reily Media, 2012.
4. References:
5. Michael C. Reingruber, William W. Gregory "The Data Modeling Handbook: A BestPractice Approach to Building Quality Data Models", Wiley QED publications, First Edition
6. Philip Bobko, "Correlation and Regression: Applications for Industrial Organizational
7. Psychology and Management", First Edition

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA435	**NATURAL LANGUAGE PROCESSING**	**L-T-P-C: 3-0-1-4**

Course Description

This course is intended as a theoretical and methodological introduction to a the most widely used and effective current techniques, strategies and toolkits for natural language processing. The ability to harness, employ and analyze linguistic and textual data effectively is a highly desirable skill for academic work, in government, and throughout the private sectors.

Course Objectives

- To understand the importance of using natural language processing when resolving issues in the real world.
- To apply and match the proper processing technique to a given situation.
- To exhibit the necessary design abilities for large collection sets. Additionally, capable of understanding and presenting cutting-edge, sophisticated NLP research materials to an audience

Course Outcome

COs	Description
CO1	Discern the concept of POS tagging and CFG for the English language.
CO2	Cognize the Vector Representation of words and skip-gram models
CO3	Explore semantic analysis algorithms and deep learning techniques, to apply them in various NLP applications.
CO4	Acquainted with Mathematical and programming tools for implementing NLP applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	3	-	1	2	1	1	1	2	1	-	-
C02	2	3	3	-	-	3	2	1	1	1	1	1	1	1	-
CO3	1	3	3	1	3	2	1	2	-	1	2	1	1	1	-
CO4	2	3	3	3	3	3	1	1	2	2	1	1	1	1	-

Syllabus

Unit I

Basics of Machine Learning, Python Programming language, Basics of Probability, Introduction - terminologies - empirical rules – Statistical Properties of words – Probability and NLP – Vector Space Models - Pre-processing- Tokenization, Parts-Of-Speech (POS) tagging, chunking, syntax parsing, Dependency parsing.

Unit II

Vector Representation of words – Contextual Understanding of text – Cooccurrence of matrix – N-grams – Dense Word Vector. Word2Vec – CBOW and Skip-gram Models – One-word learning architecture- Forward pass for Word2Vec – Reduction of complexity – subsampling and negative sampling. Continuous Skip-Gram Model, GloVe, BERT, XLNet.

Unit III

NLP Applications: Named Entity Recognition, Sentiment analysis, Text categorization using Machine learning algorithms, SVD and Latent semantic Indexing, Probabilistic Latent Semantic Indexing (pLSI) and Latent Dirichlet Allocation (LDA). Deep Learning for NLP: Neural Networks Basics, Feedforward Neural Network, Recurrent Neural Networks, LSTM, An Introduction to Transformers and Sequence-to-Sequence Learning.

Unit IV

Historical Approaches to Machine Translation – Statistical Machine Translation – Translation Models – Healthcare Data analysis and Text visualization: Summarizing lengthy blocks of narrative text, such as a clinical note or academic journal article. Answering unique free-text queries that require the synthesis of multiple data sources. Introduce Mathematical and programming tools to visualize a large collection of text documents.

Textbooks / References:

1. C.D. Manning et al, "Foundations of Statistical Natural Language Processing," MIT Press. MIT Press, 1999. isbn: 9780262133609.
2. James Allen, "Natural Language Processing with Python", O'Reilly Media, July 2009.
3. NiladriSekhar Dash and S. Arulmozi, Features of a Corpus. Singapore: Springer Singapore,2018, pp. 17–34. ISBN: 978-981-10-7458-5.
4. Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, http://www.deeplearningbook.org. MIT Press, 2016.
5. NitinIndurkhya and Fred J Damerau, "Handbook of natural language processing," Chapman and Hall/CRC, 2010.
6. Daniel Jurafsky and James H. Martin "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition," 1st. Upper Saddle River, NJ, USA: Prentice Hall PTR, 2000. isbn: 0130950696.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA436	SOCIAL MEDIA MINING	L-T-P-C: 3-0-1-4

Course Objectives

To introduce students to the fundamental concepts, theories, and techniques involved in mining data from social media platforms.

Course Outcomes

COs	Description
CO1	Students will understand the relevance of Social media Mining.
CO2	Proficiency in social media data collection.
CO3	Students will gain knowledge for Analyzing the social media data.
CO4	Knowledge in Machine learning for mining the data.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	-	-	-	3
C02	3	3	2	-	3	3	1	-	-	-	-	-	1	-	3
CO3	3	1	1	1	1	2	1	-	-	-	-	-	1	1	3
CO4	3	2	2	1	3	-	1	-	-	-	-	-	1	1	3

Syllabus

Introduction to Social Media Mining, Importance and applications of social media mining, Challenges.

Data Collection and Preprocessing, Web scraping techniques for collecting social media data, API-based data retrieval methods, Handling noise and missing data, Data cleaning and preprocessing techniques

Social Network Analysis: Graph basics, Representations, Types of Graphs, Network measures-Centrality, transitivity and reciprocity, balance and status ,similarity.

Machine Learning for Social Media Mining-Machine learning algorithms-supervised and unsupervised algorithms, Applications of machine learning in social media mining, Sentiment analysis using machine learning, Predictive modeling for social media data, Applications.

Textbooks / References:

1. Reza Zafarani, Mohammad Ali Abbasi, and Huan Liu, "Social Media Mining:An Introduction".
2. Matthew A. Russell "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Instagram, GitHub, and More".

Evaluation Criteria

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

Objective:

- Aims to equip students with basic computational and mathematical skill.
- To acquire advanced computational and modelling skills required for studying and analyzing various biological phenomenon in computational perspectives.
- To understand the basic Bioinformatics and algorithms used in Computational Biology

Course Outcomes

CO1	To provide the requisite knowledge on basic skills of mathematical analysis and computations for various applications in biological systems
CO2	To instruct theoretical and practical skills for the development and implementation of powerful computational algorithms, for representing, analyzing and simulating life at subcellular or molecular level.
CO3	To impart knowledge for the identification of new drug targets for developing rational therapeutic strategies in drug discovery.
CO4	To accomplish needs of the industry for the trained manpower with the specialized skills on computational tools.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	1
C02	2	2	2	-	-	-	-	-	-	-	-	-	1	-	1
CO3	1	2	2	-	1	3	-	-	-	3	-	3	2	-	1
CO4	2	1	3	-	-	-	-	-	-	-	-	2	-	-	1

Syllabus

Unit 1

Algorithms in Computing: Biological and Computer algorithm, Fibonacci problem, Dynamic Programming, Time and space complexity of algorithms, Laplace's Rule. Search Algorithms: Random walk, Hill climbing, simulated annealing.

Unit 2

Combinatorial Pattern Matching: Hash Tables, Repeat Finding, Exact Pattern Matching; Genetic Algorithm: Basic Concepts, Reproduction, Cross over, Mutation, Fitness Value, Optimization using GAs; Applications of GA in bioinformatics.

Unit 3

Hidden Markov Model: Markov processes and Markov Models, Hidden Markov Models. Forward and Backward Algorithms, Most probable state path: Viterbi algorithm, Parameter Estimation for HMMs:-Baum-Welch Algorithm, Applications of profile HMMs for multiple alignment of proteins and for finding genes in the DNA.

Unit 4

Support Vector Machines: Introduction, hyperplane separation (maximum and soft margin hyperplanes), linear classifier, Kernel functions, Large Margin Classification, Optimization problem with SVM, Applications of SVM in bioinformatics. Bayesian network: Bayes Theorem, Inference and learning of Bayesian network, BN and Other Probabilistic Models.

Unit 5

Artificial Neural Network: Historic evolution – Perceptron, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, Applications of ANN.

Text Books:

1. An introduction to bioinformatics algorithms by Neil C. Jones, Pavel Pevzner. MIT Press.2004

2. Biological sequence analysis: Probabilistic models of proteins and nucleic acids by Richard Durbin, Eddy, Anders Krogh, 1998

3. Algorithms for Molecular Biology by Ron Shamir Lecture, Fall Semester, 2001

4. Neural Networks: A Systematic Introduction by Raul Rojas. Springer. 1996

Reference Books:

1. Bioinformatics: the machine learning approach by Pierre Baldi, Søren Brunak. MIT Press.2001

2. Bioinformatics: Sequence and Genome Analysis: by David Mount, University of Arizona,Tucson

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

CourseObjective(s)

- Gain a foundational understanding of machine learning concepts, including supervised learning, unsupervised learning, and reinforcement learning.

- Pre-requisite: Linear algebra, Probability and statistics

CourseOutcomes

COs	Description
CO1	Familiarise with the basic methods for information extraction and retrieval of textual data
CO2	Develop the concept of apply text processing techniques to prepare documents for statistical modelling
CO3	Evaluate the performance of machine learning models for textual data
CO4	Master the concept of machine learning models for analyzing textual data and correctly interpreting the results

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-

Syllabus

Unit I

Overview: Origins and challenges of NLP Language and Grammar-Processing Indian Languages- NLP Applications Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

Unit II

Word Level Analysis: Regular Expressions Finite-State Automata - Morphological Parsing- Spelling Error - Detection and correction-Words and Word classes-Part-of Speech Tagging - Syntactic Analysis: Context-free Grammar-Constituency-Parsing-Probabilistic Parsing.

Unit III

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.

Unit IV

A Case Study in Natural Language Based Web Search:InFact System Overview, The GlobalSecurity.org Experience.

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems

Unit V

Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.

Automatic Document Separation: A Combination of Probabilistic Classification and Finite- State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.

Evolving Explanatory Novel Patterns for Semantically-Based Text Mining:
Related Work, A Semantically Guided Model for Effective Text Mining.

TEXT BOOKS:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

REFERENCES:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.

2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.

3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

EvaluationPattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA439	AUTOMATION AND ROBOTICS	L-T-P-C: 3-0-0-3

Course Description

This course provides the detailed idea about the fields of robotics and its control mechanisms.

Course Objectives

- The main objective is to provide information on various parts of robots and ideas on the fields of robotics.
- It also focuses on various kinematics and inverse kinematics of robots, trajectory
- planning of robots and to study the control of robots for some specific applications.

Course Outcomes

COs	Description
CO1	Describe the fields of robotics and explain the major components
CO2	Explain about various robot processes and functions
CO3	Discuss the various Programmable Logic Control and Experiment with various control mechanisms of robotics.
CO4	Explain the kinematics of robots and trajectory,
CO5	Implement different applications of robotics

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	3	-	3	-	-	-		1
CO2	2	1	-	-			1	-	-	1		
CO3	3		2	2		3		2		-	1	2
CO4		1				2	1		2	3		
CO5	2			1				1		1	1	1

Syllabus

Unit I

Introduction - Definition and Origin of Robotics, Types of Robotics, Major Components, Historical development of Robot, Robotic System and Robot anatomy, Degrees of freedom, Coordinate System and its type Asimov's laws of robotics, Dynamic stabilization of robots.

Unit II

Power Sources and Sensors - Hydraulic, pneumatic and electric drives, determination of HP of motor and gearing ratio, variable speed arrangements, path determination, micro machines in robotics, machine vision, ranging, laser, acoustic, magnetic, fibre optic and tactile sensors.

Unit III

Manipulators, Actuators, and Grippers - Manipulators, Classification, Construction of manipulators, manipulator dynamics and force control, electronic and pneumatic manipulator control, End effectors, Loads and Forces, Grippers, design considerations, Robot motion Control, Position Sensing.

Unit IV

Kinematics and Path Planning - Solution of Inverse Kinematics Problem, Multiple Solution Jacobian Work Envelop, Hill Climbing Techniques, Robot Programming Languages. Process Control and Types, On-Off Control Systems, Proportional Control Systems, Proportional Plus Integral (PI) Control Systems, Three Mode Control (PID) Control Systems, Process Control Tuning.

Case Studies:

Multiple robots, Machine Interface, Robots in Manufacturing and not-Manufacturing Application, Robot Cell Design, Selection of a Robot.

Laboratory Works:

The laboratory work should be focused on the implementation of sensors, design of control systems. It should also deal with developing programs related toRobot design and control using python.

Textbooks:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw Hill.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers.
3. References:
4. Jain K.C. and Aggarwal B.E., Robotics – Principles and Practice, Khanna Publishers
5. Schuler, C.A. and McNamee, W.L. Modern Industrial Electronics, Macmillan/McGraw-Hill
6. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An Integrated Approach, Prentice Hall of India.
7. Deb.S.R., Robotics Technology and Flexible Automation, John Wiley, USA 1992.
8. Asfahl C.R., Robots and Manufacturing Automation, John Wiley, USA 1992
9. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
10. Issac Asimov I. Robot, Ballantine Books, New York, 1986.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA440	**DEEP LEARNING**	L-T-P-C: 3-0-0-3

Course Objectives

- Understand the context of neural networks and deep learning
- Know how to use a neural network
- Understand the data needs of deep learning
- Have a working knowledge of neural networks and deep learning.
- Explore the parameters for neural networks

Course Outcome

COs	Description
CO1	Identify the roles of neural networks in deep learning
CO2	Standard regularisation and optimization technique for deep neural networks
CO3	Design convolution networks for various Computer Vision problems
CO4	Implement various unsupervised deep learning techniques

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	-	-	1
C02	2	2	3	-	-	-	-	-	-	-	-	-	-	-	1
CO3	2	1	1	-	1	-	-	-	-	-	-	-	-	1	1
CO4	3	1	3	1	1	-	-	-	-	-	-	-	3	-	1

Syllabus

Introduction to Neural Networks: Single Layer perceptrons, Multi Layer perceptrons, Activation functions - Sigmoid, Tanh, ReLu, Softmax, Intuition of Neural Networks Loss functions, Practical issues in neural network training - The Problem of Overfitting, the vanishing and exploding gradient problem, and ways to mitigate it.

Introduction to Deep Neural Networks: Feed forward Neural networks. Gradient descent and the back propagation algorithm, Optimization techniques - Gradient Descent, Stochastic GD, Regularization Techniques - L1 and L2 regularisation, Early stopping, Ensemble methods, Dropout, Parameter initialization
Convolutional Neural Networks - Architectures, convolution / pooling layers, Variants of convolution function, efficient convolution algorithms. Recurrent Neural Networks: Back propagation through time, Bidirectional RNNs, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs

Deep Unsupervised Learning: Auto encoders (standard, sparse, denoising, contractive, etc), Adversarial Generative Networks, Introduction to transformers, Deep Belief Networks - RBM, sampling in RBM, Applications - computer vision, speech recognition.

Textbooks / References:

Domingos, Pedro. "A few useful things to know about machine learning." Communications of the ACM 55.10 (2012): 78-87.
Li Fei-Fei (Stanford), Rob Fergus (NYU), Antonio Torralba (MIT), "Recognizing and Learning Object Categories" (Awarded the Best Short Course Prize at ICCV 2005).
Baydin, AtilimGunes, Barak A. Pearlmutter, and Alexey AndreyevichRadul. "Automatic differentiation in machine learning: a survey." arXiv preprint arXiv:1502.05767 (2015).
Bengio, Yoshua. "Practical recommendations for gradient-based training of deep architectures." Neural Networks: Tricks of the Trade. Springer Berlin Heidelberg, 2012. 437-478.
LeCun, Yann A., et al. "Efficient backprop." Neural networks: Tricks of the trade. Springer Berlin Heidelberg, 2012. 9-48.
Simonyan, Karen, Andrea Vedaldi, and Andrew Zisserman. "Deep inside convolutional networks: Visualising image classification models and saliency maps." arXiv preprint arXiv:1312.6034 (2013).
Zeiler, Matthew D., and Rob Fergus. "Visualizing and understanding convolutional networks." Computer vision–ECCV 2014. Springer International Publishing, 2014. 818- 833.
Springenberg, Jost Tobias, et al. "Striving for simplicity: The all convolutional net." arXiv preprint arXiv:1412.6806 (2014).
Russakovsky, Olga, et al. "Imagenet large scale visual recognition challenge." International Journal of Computer Vision 115.3 (2015): 211-252.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course Objective(s)

This course handles the basic trend analysis and enable the students to do multivariate trend or pattern estimation.

This estimation of the pattern helps to know how to put forth the historical knowledge to do accurate prediction in future.

Time series model is modelled with certain evaluation metric to validate how good our model work.

Course Outcomes

COs	Description
CO1	Acquire the knowledge about time series analysis and the significance of its properties.
CO2	Analyze regression, its types and importance, and the role of model selection in time series analysis.
CO3	Distinguish covariance and prediction in the context of time series data and models.
CO4	Able to classify several types of spectral representation and time series analysis estimation.
CO5	A broad primer Knowledge of multivariate and spatial time series and their applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	2	2	3	3	2	-	-	-	-	-	-	-	2	2	2
CO4	1	1	3	2	1	-	-	-	-	-	-	-	3	1	2
CO5	2	2	3	1	3	2	-	-	-	-	-	-	2	1	2

Syllabus

Unit I

Time Series - First-Order Difference Equations - Pth - order Difference Equations- Lag Operators - Initial conditions and Unbounded sequences.

Unit II

The stationary ARMA process includes white noise, estimation of time domain, auto covariance, autoregression, and moving average process. Estimation of ARMA model - ARIMA model - SARIMA - Model - Residual Analysis - Forecasting - Univariate analysis - Multivariate Analysis - Maximum Likelihood function

Unit III

Asymptotic Distribution Theory - Least squares - Linear regression Models - Generalized least squares - Instrumental Variables along with Least Squares - Equation Bias - Covariance - stationary vector process - Hypothesis testing for unrestricted vector

Unit IV

Bivariate - Granger Causality test - Impulse-response function - Variance decomposition - Standard errors for Impulse-Response functions - Bayesian Analysis - State- space models - Kalman filter.

Unit V

Multi-variate time series analysis - Modelling non-stationary series - Time series models of Heteroscedasticity - Auto-Regressive Conditional Heteroscedasticity (ARCH)

Textbooks

Chris Chatfield, "The Analysis of Time Series - An Introduction"5th Edition (revised - 2001), Chapman & Hall

James D. Hamilton, "Time Series Analysis" (2nd Edition 1994), Princeton University Press

R. H. Shumway and D. S. Stoffer (2006), Time series analysis and its applications (With R Examples, Second Edition). Springer, New York.

References

http://www-stat.wharton.upenn.edu/~stine/

"Time Series Analysis" by James Douglas Hamilton.

"The Analysis of Time Series: An Introduction" by Chris Chatfield.

"Forecasting: Principles and Practice" by Rob J. Hyndman and George Athanasopoulos.

"Introduction to Time Series Analysis and Forecasting" by Douglas C. Montgomery, Chery L. Jennings, and Murat Kulahci.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA442	INFORMATION RETREIVAL	L-T-P-C: 3-0-0-3

Course Description

This course's major goal is to offer scientific support in the subject of information search and retrieval. The course also covers both fundamental and sophisticated strategies for developing text-based information systems. Information retrieval techniques for the web, including crawling, link-based algorithms, and metadata usage, document clustering and classification are part of the course.

Course Objectives

- To understand and comprehend the highlighted IR-related issues
- To gain the skills required to build and deploy real-world applications leveraging information retrieval methods.
- To learn advanced multimodal information system approaches

Course Outcomes

Cos	Description
CO1	Be familiar with the basic methods for information extraction and retrieval of textual data.
CO2	Understand the concept of apply text processing techniques to prepare documents for statistical modelling.
CO3	Must be able to evaluate the performance of machine learning models for textual data.
CO4	Master the concept of machine learning models for analyzing textual data and correctly Interpreting the results.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	1	1			1					
CO2	3	1	1	1	3							1	1		1
CO3	2	1		1	2	1	2					1		1	
CO4	2	1		1	2	1	2					1	1		

Syllabus

Unit I

Boolean Expression Based Retrieval: Vocabulary and Postings –Lists –Dictionaries and Tolerant Retrieval –Index Construction and Compression -Scoring and Vector Space Model–Score Computation.

Unit II

Evaluating Information Retrieval Systems. Relevance Feedback and Query Expansion –XML Based Retrieval–Probabilistic Models –Language Models-Text Classification –Vector Space Classification –SVM Based Document. Data Fusion -Metasearch Data fusion, early and late fusion, Metasearch engines of retrieval.

Unit III

Latent Semantic Indexing –Web Search –Web Crawlers –Link Analysis –Unstructured Data Retrieval Semantic Web.

Unit IV

Ontology -Implementations using Natural Language Toolkit. Distributed Information Retrieval: A theoretical Model of Distributed retrieval, web search.

Textbooks / References:

1. C. Manning, P. Raghavan and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. R. Baeza-Yates and B. RibeiroNeto, "Modern Information Retrieval: The Concepts and Technology Behind Search", Second Edition, Addison Wesley, 2011.
3. David A. Grossman and Ophir Frieder "Information Retrieval: Algorithms and Heuristics", Second Edition, Springer 2004.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA443	PATTERN RECOGNITION	L-T-P-C: 3-0-0-3

Course Description

Automated systems that increase their own performance via experience are designed using pattern recognition algorithms. This course examines statistical pattern identification from several aspects, including techniques, tools, and algorithms. Students will learn various techniques like Bayesian Decision Theory, Estimation Theory, Linear Discrimination Functions, Nonparametric Techniques, Support Vector Machines, Neural Networks, Decision Trees, and Clustering Algorithms.

Course Objectives

- To understand the fundamentals of pattern recognition.
- To explore the most cutting-edge algorithms and techniques used in pattern recognition research.
- To learn pattern recognition theories such as Bayes classifier and linear discriminant analysis and to use the techniques to solve real-world challenges.

Course Outcome

Cos	Description
CO1	Implement the concepts of Tree classifiers and decision trees on patterns
CO2	Design both supervised and unsupervised classification methods to develop classifiers for real-world data.
CO3	Apply advanced techniques like Dimensionality Reduction for different features
CO4	Compare various techniques used by different clustering algorithms

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	1		-
C02	3	2	2	1	2	-	-	-	-	-	-	-	1	1	
CO3	2	2	3	2	2	-	-	-	-	-	-	-	1	1	
CO4	2	2	3	2	2	2	2	-	-	-	-	-	1	1	

Syllabus

Unit I

Introduction to Pattern Recognition-Tree Classifiers Getting our feet wet with real classifiers, Decision Trees: CART, C4.5, ID3-Random Forests-Bayesian Decision Theory Grounding our inquiry-Linear Discriminants Discriminative Classifiers: the Decision Boundary, Separability, Perceptron.

Unit II

Support Vector Machines, Parametric Techniques Generative Methods grounded in Bayesian Decision Theory, Maximum Likelihood Estimation-Bayesian Parameter Estimation. Non-Parametric Techniques-Kernel Density Estimators-Nearest Neighbor Methods, Unsupervised Methods.

Unit III

Exploring the Data for Latent Structure -Component Analysis and Dimension Reduction-The Curse of Dimensionality, Principal Component Analysis, Fisher Linear Discriminant, Locally Linear Embedding.

Unit IV

Clustering, K-Means. Expectation Maximization, Mean Shift, Classifier Ensembles, Bagging, Boosting / AdaBoost.

Textbooks / References:

1. Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.

2. T.M. Mitchell, Machine learning, McGraw-Hill, New York, 1997.

3. S. Theodoridis, K. Koutroumbas, Pattern recognition, Academic Press, 1999

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA444	RECOMMENDATION SYSTEMS	L-T-P-C: 3-0-0-3

Course Objectives

- To develop state-of-the-art recommendation systems that automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality
- Recommendations and focusing on theory as well as on the practical use and applications of Recommender systems.

Course Outcomes

Cos	Description
CO1	Understand basic idea of Recommendation system and its applications in various fields.
CO2	Explore the various recommendation systems, analyze the content based and collaborative filtering methods.
CO3	Understand Hybrid approaches and its applications in recommender systems
CO4	Apply different methods to build and evaluate recommender systems on historical datasets, conceive the various recommendation metrics.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
C02	1	1	1	-	1	-	-	-	-	-	-	-	1	1	1
CO3	1	1	1	-	1	-	-	-	-	1	-	-	-	1	1
CO4	1	1	1	1	1	-	-	-	-	-	-	-	-	1	1

 Prerequisites

Data mining

Machine learning

Syllabus

Unit I

Introduction and basic taxonomy of recommender systems (RSs). Traditional and non-personalized RSs. Overview of data mining methods for recommender systems, Applications of recommendation systems, Issues with recommender system.

Unit II

Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Basic components of content-based RSs. Feature selection. Item representation Methods for learning user profiles. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

Collaborative Filtering: User-based nearest neighbour recommendation, Item-based nearest neighbour recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems

Unit III

Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Featurecombination, Feature augmentation, Parallelized hybridization design: Weighted, Switching,Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.

Unit IV

Evaluating Recommender System: Introduction, General properties of evaluation research,Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics.

Textbooks / References:

1. C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.

2. F. Ricci, L Rokach, B. Shapira and P.B. Kantor, Recommender systems handbook, Springer 2010.

3. J. Leskovec, A. Rajaraman and J. Ullman, Mining of massive datasets, 2nd Ed., Cambridge, 2012. (Chapter 9).

4. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.

5. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.

6. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems for Learning, Springer (2013), 1st ed.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA445	WEB MINING	L-T-P-C: 3-0-0-3

Course Description

Web mining aims to discover useful information and knowledge from the Web hyperlink structure, page contents and usage logs. It has direct applications in e-commerce, Web analytics, information retrieval/filtering, personalization, and recommender systems. Employees knowledgeable about Web mining techniques and their applications are highly sought by major Web companies such as Google, Amazon, Yahoo, MSN and others who need to understand user behavior and utilize discovered patterns from terabytes of user profile data to design more intelligent applications.

Course Objectives

- Introduce students to the basic concepts and techniques of Information Retrieval, Web Search, Data Mining, and Machine Learning for extracting knowledge from the web.
- Develop skills of using recent data mining software for solving practical problems of Web Mining.
- Gain experience of doing independent study and research

Course Outcomes

Cos	Description
CO1	Perceive Information Retrieval Models, explore web preprocessing and community discovery
CO2	Design and implement a crawler application to collect and index documents from the web and analyse structured data extraction.
CO3	Analyze text to determine the reliability of the information including potential bias. Explore web usage mining and opinion mining with case studies.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	2	-	-	-	2	1	1	-	1
CO2	2	2	3	-	3	-	1	-	-	1	2	1	-	-	1
CO3	2	2	3	2	3	-	1	-	-	-	2	1	-	-	-

Prerequisites

Data Mining concepts

Syllabus

Unit I

Information Retrieval and Web Search: Information Retrieval Models, Text and Web Page Pre-Processing - Stopword Removal, Stemming, Web Page Pre-Processing, Inverted Index and Its Compression - Inverted Index, Search Using an Inverted Index. Latent Semantic Indexing, Web Search, Web Spamming. Link Analysis: Social Network Analysis, Co-Citation and Bibliographic Coupling, PageRank, HITS, Community Discovery- Bipartite Core Communities, Maximum Flow Communities, Email Communities Based on Betweenness.

Unit II

Web Crawling: A Basic Crawler Algorithm - Breadth-First Crawlers, Preferential Crawlers. Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers, Evaluation, Crawler Ethics and Conflicts. Structured Data Extraction: Wrapper Induction, Automatic Wrapper Generation, String Matching and Tree Matching, Multiple Alignment, Extraction Based on a Single List Page and Multiple pages.

Unit III

Information Integration: Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema-Level Match, Domain and Instance-Level Matching, Combining Similarities, Integration of Web Query Interfaces. Opinion Mining: Sentiment Classification, Feature-Based Opinion Mining and Summarization, Comparative Sentence and Relation Mining, Opinion Search, Opinion Spam. Web Usage Mining: Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns - Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Analysis of Sequential and Navigational Patterns.

Textbooks / References:

Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications) by Bing Liu, Springer Publisher.

1. Mining The Web: Discovering Knowledge From Hypertext Data by Chakrabarti Soumen, Elsevier Science
2. Web Mining: Applications and Techniques, Anthony Scime (State University of New York at Brockport, USA) Release Date: August, 2004|Copyright: © 2005 |Pages: 442 ISBN13: 9781591404149|ISBN10: 1591404142|EISBN13: 9781591404163, IGI Global Publisher.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA446	DATA GOVERNANCE	L-T-P-C: 3-0-0-3

CourseObjective(s)

Delving into Data Governance aids individuals in comprehending the laws and regulations dictating data management. It enables them to devise and execute policies and procedures ensuring adherence to compliance standards.

Engaging in Data Governance empowers individuals with the expertise required to effectively manage data across its lifecycle, encompassing collection, utilization, and disposal phases. Furthermore, it equips them with data management tools and methodologies aimed at enhancing data quality and consistency.

CourseOutcomes

COs	Description
CO1	Comprehend the necessity of Data Governance within organizations and analyse how organizational culture influences Data Governance practices and articulate the challenges associated with implementing Data Governance
CO2	Identify the various types of assets that require governance and Assess different data models and their implications on Data Governance.
CO3	Analyse the relationship between data stewardship and Data Governance and understand the types of data stewardship roles and responsibilities within organizations.
CO4	Develop a framework for successful Data Governance strategies and understand the importance of information exchanges in Data Governance implementations.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	-	-	2	-
CO2	3	-	-	-	-	-	2	-	-	-	-	-
CO3	-	3	-	2	-	-	2	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-

Syllabus

Unit 1

Data Governance -The Need for Data Governance - How Data Governance fits into Organizational Strategy Data Governance Maturity Models -Data Governance Life Cycle - how to Manage Risk with Data Governance - Or- ganizational Culture Affects Data Governance - Articulate the Challenges of Data Governance

Unit 2

Metadata Framework - Evaluate and Explain Master Data Management - Types of Assets that Require Governance - Analyze and Describe Metadata Use for Data Governance - Evaluate the Varying Data Models and Their Bearing on Governance Regulatory and Operational Risk Through Data Governance - The Relationship Between IT and Business in an Organization - Information Governance Framework Optimize Performance with Data Governance - Formal Structure Impacts Data Governance - Create a Data Governance Document that Describes the Business Need for Data Governance

Unit 3

Data Stewardship and Governance – How they fit together – Types of data stewardship – Roles and responsibilities

Unit 4

Application of Data Governance in Business - Challenges of Data Governance in a Big Data world - Frame- work for successful Data Governance strategies - Information Exchanges

References

1. Data Governance: Creating Value from Information Assets, Neera Bhansali, 2013. Auerbach Publications, ISBN: 978-1439879139.
2. Data Governance: Perspectives and Practices, Harkish Sen, Technics Publications, 2019
3. Data stewardship: an actionable guide to effective data management and data governance, David Plotkin, Amsterdam : Elsevier, 2014

EvaluationPattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA447	COMPUTATIONAL INTELLIGENCE	L-T-P-C: 3-0-0-3

Course Objectives

The Objective of the course is to make students familiar with basic principles of various computational methods of data processing that can commonly be called computational intelligence. This course introduces the fundamentals of key intelligent systems technologies including knowledge-based systems, neural networks, fuzzy systems, and evolutionary computation.

Course Outcomes

COs	Description
CO1	Understand the need for and importance of Computational intelligence.
CO2	Understand the concepts of neural networks and backpropagation learning.
CO3	Implement associative memory using neural networks.
CO4	Understand the idea of fuzzy logic in real-world problems.
CO5	Understand hybrid approaches to solve real-world problems.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	2	-	1
CO4	2	3	3	-	-	-	-	-	-	-	-	-	1	-	1
CO5	2	3	3	-	-	-	-	-	-	-	-	-	2	-	3

Prerequisites
Machine Learning
Programming languages
Probability

Syllabus

Unit I

Artificial Intelligence – a Brief Review – Pitfalls of Traditional AI – Need for Computational Intelligence – Importance of Tolerance of Imprecision and Uncertainty – Overview of Artificial Neural Networks - Fuzzy Logic – Evolutionary Computation.

Unit II

Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron - Multilayer Perceptron – Backpropagation Learning.

Unit III

Neural Networks as Associative Memories - Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks – Competitive Learning, Kohonen Maps.

Unit IV

Fuzzy Logic: Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. Fuzzy Logic and Fuzzy Inference - Applications. Evolutionary Computation – Constituent Algorithms.

Unit V

Swarm Intelligence Algorithms - Overview of other Bio-inspired Algorithms - Hybrid Approaches (Neural Networks, Fuzzy Logic, Genetic Algorithms etc.). Case Studies: Prediction Models, Optimization Models.

Textbooks / References:

Laurene Fausett, Fundamentals of Neural Networks, 2nd edition, Pearson, 1993

Ross T J, ―Fuzzy Logic with Engineering Applications‖, McGraw Hill, 1997.

Eiben A E and Smith J E, ―Introduction to Evolutionary Computing‖, Second Edition, Springer, Natural Computing Series, 2007.

Kumar S, ―Neural Networks - A Classroom Approach‖, Tata McGraw Hill, 2004.

Engelbrecht, A.P, ―Fundamentals of Computational Swarm Intelligence‖, John Wiley & Sons, 2006.

Konar. A, ―Computational Intelligence: Principles, Techniques and Applications‖, Springer Verlag, 2005.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course Objective(s)

2. To provide an understanding of the fundamental concepts of Artificial Intelligence
3. To provide the understanding of how machine learning can be applied to various real world applications.
4. To provide insight into applications of AI in various disciplines.

Course Outcomes

COs	Description
CO1	Describe the key concepts of AI
CO2	Explain machine learning concepts
CO3	Discuss about neural networks and its variants
CO4	Discuss about Text processing and language models
CO5	Discuss about applications of AI in various fields

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	1	-	-	-	-	-

Syllabus

Unit I

Introduction to AI- History and evolution, Key concepts and defenitions, overview of Machine learning, neural networks, natural language processing

Unit II

Machine Learning Fundamentals: Supervised vs. unsupervised learning, Regression, classification, and clustering, Evaluation metrics and model validation

Unit III

Basics of neural networks: Introduction to deep learning: CNNs, RNNs, Applications in image and speech recognition

Unit IV

Natural Language Processing (NLP): Text preprocessing and representation, Language models and transformers, Applications in text generation, sentiment analysis, and machine translation

Unit V

AI in Healthcare and Biology: AI applications in medical imaging, diagnostics, and personalized medicine, Machine learning for genomics and drug discovery. AI in Social Sciences and Humanities: AI in economics: predictive analytics, market analysis, AI in psychology: behavioral modeling, cognitive simulations, Ethical and societal implications of AI

References

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. Pattern Recognition and Machine Learning" by Christopher Bishop.
3. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
4. Speech and Language Processing" by Daniel Jurafsky and James H. Martin.
5. The Ethics of Artificial Intelligence" by Nick Bostrom and Eliezer Yudkowsky

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24CSA451	SYSTEM SECURITY	L-T-P-C: 3-0-1-4

Course Objectives

Students will learn the fundamentals of securing a computer system. They will understand and implement defences against all common system attacks.

Course Outcomes

COs	Description
CO1	Describe security goals and principles which is used in designing a secure system.
CO2	Demonstrate the exploitation of Access control vulnerabilities and develop its mitigation.
CO3	Explain the basics of system organization, assembly language and Linux system calls.
CO4	Demonstrate buffer overflow attack, format string attack and Return to libc attack with examples.
CO5	Understand the preventive mechanisms for different exploits.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1										2	1
CO2	1		1	2	1	1								1	
CO3	3	1												1	
CO4	1														1
CO5	2	1	1		1										1

Syllabus

Unit I

Security Goals, Secure Design Principles

Unit II

Authentication, Linux Password scheme, Password Security, Authorization - Access control, MAC, DAC, ACL, Capabilities, Information flow control, Privilege Escalation Attacks, constraining and sandboxing users and applications.

Unit III

Assembly Primer, Shell coding, ELF File Format.

Unit IV

Memory Exploits – Buffer Overflow, off by one overflow, Format String Attacks, Integer Overflow, Return to Libc, Heap Overflow, Exploit prevention mechanisms: stack canaries,

Unit V

Data Execution Prevention, Address Space Layout Randomization, bypassing DEP & ASLR. Trusted Execution Environment - Case Study on IntelSGX. Fuzzing - Types of fuzzers, Bug detection, Case study - AFL fuzzer. Vulnerability and exploit analysis: spectre, meltdown, foreshadow, dirty COW.

Textbooks / References:

1. Neil Daswani, Christopher Kern, Anita Kesavan, "Foundations of Security, What Every Programmer Needs to Know", Apress, 2007
2. Jon Ericson, "Hacking: The Art of Exploitation", Second Edition, No Starch Press, 2008
3. Gary McGraw, John Viega, "Building Secure Software", Addison-Wesley Professional, 2001.
4. Michael Sutton, Adam Greene, Pedram Amini, "Fuzzing Brute Force Vulnerability Discovery".

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

| 24CSA452 | WEB APPLICATION SECURITY | L-T-P-C: 3-0-1-4 |

Course Objectives

Students will learn the fundamentals of web application security. They will focus on wide aspects of secure development and deployment of web applications .Learn how to build secure APIs
and the basics of vulnerability assessment and penetration testing. To get an insight about Hacking techniques and Tools.

Course Outcomes

COs	Description
CO1	Understanding the basic concepts of web application security and the need for it.
CO2	Demonstrate with the process for secure development and deployment of web applications
CO3	Explain the skill to design and develop Secure Web Applications.
CO4	Demonstrate the importance of carrying out vulnerability assessment and penetration testing.
CO5	Understand the skill to think like a hacker and to use hackers tool sets.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								1				2			3
CO2					1			1				2			2
CO3					2							1			
CO4	1	2	3	1	3	1						3		2	
CO5	2	1	3	1	2							2		2	1

Syllabus

Unit I

 Fundamentals Of Web Application Security:-The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation.

Unit II

Secure Development And Deployment:-Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

Unit III

Secure Api Development:-API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

Unit IV

Vulnerability Assessment And Penetration Testing:-Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

Unit V

Hacking Techniques And Tools:-Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

Textbooks / References:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.

2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.

3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA453	**NETWORK SECURITY**	**L-T-P-C: 3-0-1-4**

Course Objectives

This course provides an overview of the fundamentals of network security, including the threats, attacks, and the measures to mitigate them.

Course Outcomes

COs	Description
CO1	Explain network security services and mechanisms and explain security concepts
CO2	Illustrate the concept of Transport Level Security and Secure Socket Layer
CO3	Explain Security concerns in Internet Protocol security
CO4	Describe VPN and the configuration and usage
CO5	Describe Firewalls, Firewall Characteristics, Biasing and Configuration, Intruders, and Intrusion Detection

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	1	2	-	3	-	-	-	-	-	-	-	2	-	-
CO3	-	1	2	-	3	-	-	-	-	-	-	-	2	-	-
CO4	-	1	3	-	3	-	-	-	-	-	-	-	2	-	-
CO5	-	1	3	-	3	-	-	-	-	-	-	-	2	-	-

Syllabus
Unit I
Introduction to Network Security:
Need for Security, Security Approaches, Principles of Security Types of Attacks.
Unit II
Transport Level Security:
Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)
Unit III
IP Security:
Overview of IP Security (IPSec),IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange.
Unit IV
Virtual Private Networks (VPNs):
Understanding VPNs, VPN Protocols, Configuring VPNs
Unit V
Firewalls and Intrusion Detection Systems:
Types of Firewalls, Configuring Firewalls, Intrusion Detection and Prevention Systems

Textbooks / References:

1. Cryptography and Network Security Principles and Practice, William Stallings,Seventh Edition
2. Cryptography and Network Security, Behrouz A. Forouz.an, TMH, 2007

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA454	**VAPT (VULNERABILITY AND PENETRATION TESTING) L-T-P-C: 3-0-1-4**

Course Objectives

The student will be confident to perform vulnerability and penetration testing for any organization or product team, generate a report and communicate remediation steps.

Course Outcomes

COs	Description
CO1	Ability to perform vulnerability analysis in networks and web services
CO2	Understand the weakness in password management and perform penetration to system using password weakness
CO3	Ability to use different tools for network and packet analysis
CO4	Ability to perform various type of injection attacks
CO5	Ability to generate vulnerability assessment report

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	1	-	-	-	-	-	-	1	-	1
C02	1	1	1	1	-	1	-	-	-	-	-	-	1	1	1
CO3	1	1	1	1	2	1	1	-	-	-	-	-	1	1	1
CO4	1	1	1	1	2	1	1	-	-	-	-	-	1	1	1
CO5	1	1	1	1	2	1	1	-	-	1	-	-	1	1	1

Syllabus

Unit I

Active information gathering, General vulnerability scanners, Port-based, Service-based, Banner grabbing, Web application scanners, General application flaw scanners, Directory listing/Brute forcing, Web server version/Vulnerability identification, Technology stacks and packages version detection, Network vulnerability scanners/Specific protocols, VPN, Manual direct connections.

Unit II

Passive information gathering, Metadata analysis, Traffic monitoring, ARP/MAC cache overflow,Etherleak, Misconfigured clusters or load balancers

Public Research: Vulnerability databases, Vendor advisories, Exploit databases and framework modules, Common/default passwords, Hardening guides/common misconfigurations, Private Research, Fuzzing. Wi-Fi password hacking, aircrack-ng,

Unit III

DNS Cache poisoning/Spoofing, Recon tools: NS enumeration tools, Nmap, Netcat, Tcpdump, Wireshark, Directory enumeration tools, Google hacking, Shodan.

Unit IV

SQL injection Case study: SQLi, File upload vulnerabilities, Case study: SSRF , Reverse shell, Password brute-forcing using shadow file, Hashcat, John the ripper, Hydra, Medusa, Ncrack, Cross site scripting , XSS, Client-side request forgery, IDOR, Metasploit.

Unit V

XML attacks, Case study: XXE, Vulnerability Exploitation and Generating PoC, Vulnerability assessment, Pen Test Report Generation.

Textbooks / References:

1. OWASP Web Security Testing Guide V4
2. Bugcrowd, "The Ultimate Guide to Penetration Testing", 2020 edition
3. HackerOne, "Web hacking 101"

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA455	SMART CONTRACTS AND BLOCKCHAIN SECURITY	L-T-P-C: 3-0-1-4

Course Objectives

- Understand the challenges of smart contract security
- Explore common smart contract vulnerabilities
- Discuss best practices for smart contract security
- Identify key components of a smart contract security audit
- Understand different types of smart contract vulnerabilities

Course Outcome

COs	Description
CO1	Understand blockchain and smart contracts
CO2	Understand security concepts related to smart contracts
CO3	Discuss about General Programming Vulnerabilities
CO4	Understand Blockchain Vulnerabilities
CO5	Understand Ethereum-Specific Vulnerabilities

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO2	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO3	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO4	1	1	1	1	1	-	-	-	-	-	-	-	2	-	2
CO5	1	1	1	1	1										

Introduction to blockchain-smart contracts--Origin and Purpose-Types of Blockchains-Smart Contract Overview-Common Use Cases Introduction to smart contract security- The complexity of Smart Contract Security- Smart Contract Security Risks-Tools for Smart Contract Security- The Importance of Smart Contract Audits- Process for Smart Contract Security Audits- Best Practices for Smart Contract Securit

General Programming Vulnerabilities- Arithmetic Vulnerabilities-External Library Functions-Right-to-Left Control Characters Blockchain Vulnerabilities-Blockchain-Specific Vulnerabilities-Access Control Vulnerabilities-Denial of Service Vulnerabilities-Frontrunning-Rollback Attacks-Timestamp Dependence-Weak Randomness
Ethereum-Specific Vulnerabilities-Introduction to Ethereum Vulnerabilities-DoS Block Gas Limits-DoS Unexpected Revert-Forced Send of Ether-Reentrancy Vulnerability

Textbooks / References:

1. Fundamentals of Smart Contract Security Authors Richard Ma, Jan Gorzny, Edward Zulkoski, Kacper Bak, Olga V. Mack Publisher Momentum Press, 2019

2. Mark Gates, "Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money", Wise Fox Publishing and Mark Gates 2017.

3. Smart Contracts: Author: Patrick Ejeke Amazon Asia-Pacific Holdings Private Limited

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

| 24CSA456 | **DATABASE SECURITY FUNDAMENTALS** | **L-T-P-C: 3-0-1-4** |

Course Description

- Database security includes a variety of measures used to secure database management systems from malicious cyber-attacks and illegitimate use. Database security programs are designed to protect not only the data within the database, but also the data management system itself, and every application that accesses it, from misuse, damage, and intrusion. It refers to the range of tools, controls and measures designed to establish and preserve database confidentiality, integrity and availability.

Course Objectives

This course will cover the various authentication and authorization mechanisms to protect the database. It also covers about the different threats and vulnerabilities and need for securing resources and exercising privacy preservation.

Course Outcomes

COs	Description
CO1	List the fundamental concepts of database design, various threats and vulnerabilities.
CO2	Summarise the various Database Security concepts and approaches.
CO3	Use of various tools to avoid execution of malicious SQL statements.
CO4	Illustrate the various locking mechanisms for concurrency control.
CO5	Demonstrate Cryptographic schemes on datasets.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	1	-	-	-	-	-	-	-	-
CO3	2	2	2	2	2	-	3	-	-	-	1	-	1	-	1
CO4	2	3	3	1	2	-	2	1	-	1	1	1	1	-	-
CO5	3	3	3	1	2	-	1	-	-	-	1	-	-	-	1

Syllabus

Database security – Introduction includes threats, vulnerabilities and breaches, Basics of database design. DB security – concepts, approaches and challenges, types of access controls, Oracle VPD. Discretionary and Mandatory access control – Principles, applications and poly-instantiation, Database inference problem, types of inference attacks, distributed database, security levels. SQL-injection: types and advanced concepts, Security in relational data model, concurrency controls and locking, SQL extensions to security (oracle as an example). System R concepts, Context and control-based access control, Hippocratic databases, Database watermarking, Database intrusion, Secure data outsourcing. Security issues in big data. Implementing Cryptographic schemes on datasets. Tools: Snort, NPM, Open VAS, Nessus.

Textbooks / References:

1. Michael Gertz and Sushil Jajodia, "Handbook of Database Security — Applications and Trends", Springer, 2008.
2. Bhavani Thuraisingham, "Database and Applications Security", Integrating Information Security and Data Management, Auerbach Publications, 2005.Alfred Basta, Melissa Zgola, "Database Security", Course Technology, 2012.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	20
Continuous Assessment (Theory)	10
Continuous Assessment (Lab)	40
End Semester Exam	30
Total Marks	100

24CSA457	Essentials of Cyber Security	L-T-P-C: 3-0-0-3

Course Description

This course introduces the basic Linux commands and the fundamentals of cyber security. It helps students to develop the essential skills for reverse engineering and malware analysis.

Course Objectives

The student will learn to navigate a Linux CLI and run basic bash commands. The student gains an understanding of the common architecture and platforms. Students will practice basic cryptography with code, as well as analyzing malicious binaries.

Course Outcomes

COs	Description
CO1	Identify the essential principles behind currently used cryptographic algorithms.
CO2	Interpret the usage and fundamental principles behind the GNU/Linux operating system.
CO3	Illustrate reverse engineering skills associated with the x86/x86-64 platform.
CO4	Explain how to perform analysis of malicious binaries.
CO5	Summarize stack and heap exploits on system calls.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	1	2	-	-	-	-	-	-	-	1	-	-
CO2	-	-	3	1	-	-	-	-	-	-	-	-	2	-	-
CO3	1	3	3	1	3	-	-	-	-	-	-	-	1	-	-
CO4	1	3	3	1	3	-	-	-	-	-	-	-	2	-	-
CO5	1	3			3								-	-	-

Syllabus

Unit I

Cryptography: Kerkhoff's principle, Symmetric key encryption, Asymmetric key encryption, MAC, Digital signatures, TLS cryptography, Password hashing.

Unit II

Linux: Shell essential concepts, Shell I/O, Linux Paths and File Manipulation, Linux permissions.

Unit III

System security: System calls, Context switches, Malware Analysis, Static and dynamic analysis, Windows API,

Unit IV

Malware identification, Malware disassembly.

Textbooks / References:

1. Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C. (2018). Operating systems: Three easy pieces. Arpaci-Dusseau Books LLC.
2. David Wong. (2021). Real-World Cryptography. Manning Publishing.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA458	MALWARE ANALYSIS	L-T-P-C: 3-0-0-3

Course Objectives

This course aims to identify malware types based on static and behavioral analysis, determine malware capabilities and persistence vectors and evaluate potential threat from malware activity on the network.

Course Outcomes

COs	Description
CO1	Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
CO2	Identify executable formats, Windows internals and API, and analysis techniques.
CO3	Extract investigative leads from host and network-based indicators associated with a malicious program.
CO4	Achieve proficiency with industry standard tools including IDA Pro, OllyDbg, WinDBG, PE Explorer, ProcMon etc.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	1	2	-	-	-	-	-	-	-	1	-	-
CO2	1	1	3	1	-	-	-	-	-	-	-	-	1	-	-
CO3	1	3	3	1	3	-	-	-	-	-	-	-	1	-	-
CO4	1	3	3	1	3	-	-	-	-	-	-	-	1	-	-

Syllabus

Unit 1

Introduction to malware, Basic Static and Dynamic Analysis, Overview of Windows file format, PEView.exe, Patching Binaries , Disassembly(objdump, IDA Pro),

Unit 2

Introduction to IDA, Introduction to Reverse Engineering, Extended Reverse Engineering using GDB and IDA

Unit 3

Advanced Dynamic Analysis - debugging tools and concepts, Malware Behavior - malicious activities and techniques, Analyzing Windows programs – Win API, Handles ,Networking , COM, Data Encoding, Malware Countermeasures

Unit 4

Intro to Kernel – Kernel basics, Windows Kernel API, Windows Drivers, Kernel Debugging, Rootkit Techniques- Hooking, Patching, Kernel Object Manipulation , Rootkit Anti-forensics , Covert analysis.

Textbooks / References:

1. Michael Sikorski and Andrew Honig, " Practical Malware Analysis", No Starch Press,2012
2. Jamie Butler and Greg Hoglund, "Rootkits: Subverting the Windows Kernel", Addison-Wesley, 2005
3. Dang, Gazet and Bachaalany, "Practical Reverse Engineering",Wiley,2014
4. Reverend Bill Blunden, "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System" Second Edition, Jones& Bartlett, 2012.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

| 24CSA459 | **BLOCKCHAIN AND DECENTRALIZED APPLICATIONS** | L-T-P-C: 3-0-0-3 |

Course Objectives

- To provide understanding about Blockchain Technology and its applications
- To provide insights to dApps and Smart Contracts

Course Outcome

CO1	Exploring the fundamentals of Blockchain, Types & Generations of Blockchains, Enterprise Blockchains, Blockchain Mechanics & Optimizations and Blockchain Consensus Algorithms
CO2	Familiarizing with Blockchain IRL, Network & Wallet Attacks, Scaling and Future of Blockchains
CO3	Understanding Bitcoin, Altcoins and Forking
CO4	Exploring Ethereum, dApps – Smart Contracts and related Languages & Tools,Forking, Stablecoins, Token Specifications, NFTs, DeFi and DAO
C05	Exploring Attack on Digital assets, Cryptocurrencies for the Masses, Funding Crypto development, How to destroy Cryptocurrencies? Digital Asset applications and Enterprise Real-World applications,- Familiarizing with Hyperledger Fabric, Fabric Network, Chaincode and related Languages & Tools

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO2	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO3	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO4	1	1	1	1	1	-	-	-	-	-	-	-	2	-	2
CO5	1	1	1	1	1										

Syllabus

Blockchain History. What is a Blockchain? Do you need a Blockchain? Permission-less vs Permissioned Blockchains, Public vs Private vs Hybrid vs Consortium Blockchains, Enterprise Blockchains (Hyperledger, R3 Corda), Generation of Blockchains – Bitcoin (First), Ethereum (Second with dApps), Cosmos (Third as IOB – Internet of Blockchains) Introduction to Cryptography, Public Key Cryptography, Cryptographic primitives – Cryptographic hash functions and Digital signatures, Elliptic Curve Digital Signature Algorithm (ECDSA), Crypto-economics

Blockchain Mechanics and Optimizations – Structure, Architecture, GHOST Protocol, Mining Process, Blockchain Demos Blockchain Consensus Algorithms – Proof-of-Work (POW), Proof-of-X (POX) – Proof-of-Stake (POS), Delegated POS (DPOS), Byzantine Fault Tolerance (BFT), Practical BFT (PBFT), Ripple Protocol Consensus Algorithm (RPCA), Unique Node Lists (UNL), Paxos & Multi-Paxos, Raft, Proof-of-Authority (POA), Proof-of-Importance (POI), Proof-of-Elapsed-Time (POET), SIEVE, Proof-of-Weight (POW), Proof-of-Burn (POB), Proof-of-Activity (POA), Proof-of-Capacity (POC), Proof-of-Deposit (POD), Proof-of-Retrievability (POR), Proof-of-Luck (POL) and Tendermint BlockDAG & Blockless DAG Protocols – SPECTRE, PHANTOM and GHOSTDAG Blockchain IRL – Public & Private Keys, Hot and Cold Storages, Wallets, Lite Clients & Full nodes, Miners, Block & Transaction Incentives, Mining Infrastructure, Mining Pools & Organizations Languages & Tools – Bitcoin Scripting language, Ethereum Smart Contracts using Solidity language with Tools (ethPM / npm, Node.js, EVM, Truffle, Remix IDE, Ganache, MetaMask, web3.js etc. …) and Hyperledger Fabric Chaincodes in GO language Anonymity, Attacks on Blockchain Networks & Wallets, Scaling of Blockchains, Future of Blockchains Decentralized Applications: Cryptocurrencies (Internet of Money) – History, Bitcoin, Ethers & Gas (Ethereum) and Atom (Cosmos), Introduction to Altcoins & Stablecoins, DOT (Polkadot), Ripple, Stellar & IOTA,

Forking of Cryptocurrencies, Attack on Digital Assets, Cryptocurrencies for the Masses, Funding Crypto development (Crowd Funding, ICO & STO), How to destroy Cryptocurrencies? Token Specifications, Non-Fungible Tokens (NFTs – Internet of Assets), Decentralized Finance (DeFi) and Decentralized Autonomous Organizations (DAO)Digital Asset applications (Cryptokitties …) and Enterprise Real-World applications

Textbooks / References:

1. Blockchain Technology by Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan
2. Blockchain Applications – A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti
3. Bitcoin and Cryptocurrency Technologies by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder
4. Mastering Bitcoin by Andreas Antonopoulos
5. Mastering Ethereum, Building Smart Contracts and dApps by Andreas Antonopoulos and Dr Gavin Wood

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA460	FUNDAMENTALS OF CYBER SECURITY OPERATIONS	L-T-P-C: 3-0-0-3

Course Objectives

The course teaches students security concepts, common network and application operations and attacks, and the types of data needed to investigate security incidents. Students will learn how to monitor alerts and breaches and become contributing members of a Cyber security Operations Center (SOC) including understanding the IT infrastructure, operations, and vulnerabilities.

Course Outcomes

COs	Description
CO1	Students should be able to understand the functionalities of various SOC generations.
CO2	Understand different data collection, data analysis, and security analysis techniques as part of SOC technologies.
CO3	Understand the vulnerability management techniques and threat intelligence methodologies.
CO4	Assess the SOC capabilities using different SOC tools and techniques.
CO5	Learn how SOC helps in business continuity and disaster recovery plan.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	1	-	1	-	-	-	-	-	-	1	-	1
C02	1	1	1	1	-	1	-	-	-	-	-	-	-	1	1
CO3	1	1	1	1	-	1	1	-	-	-	-	-	-	1	1
CO4	1	1	1	1	1	1	1	-	-	-	-	-	1	1	1
CO5	1	1	1	1	-	1	1	1	-	1	-	-	1	1	1

Syllabus

Information security incident management (Incident detection, triage and incident categories, Incident severity, resolution, Closure, Post-incident), Security Operations Center (SOC) Generations (First-generation, second, third and fourth generation SOC), SOC Maturity models (Introduction to maturity models, and applying maturity models in SOC), SOC Technologies-1 (Data collection and analysis, syslog protocol), SOC Technologies-2 (Telemetry Data, Security analysis, Data enrichment), Vulnerability Management (Broad introduction), Threat intelligence (Broad introduction), Assessment of SOC capabilities (Business and IT Goals, Assessing capabilities & IT processes), SOC - Business Continuity, Disaster recovery (Importance of BCP and DR processes, and its interface to SOC), Security event generation and collection (Cloud Security, IDPS, Breach Detection), SOC and SIEM – Introduction (Role of SIEM in SOC), SOC and Splunk (Splunk architecture & SOC, Splunk Rules, Splunk log management, Splunk correlation), SOC and Health Care - A Case study (SOC Considerations for a HealthCare situation), SOC and Application security (OWASP, Application security and SOC).

Textbooks / References:

1. Security Operations Center: Building, Operating, and Maintaining Your SOC, Book by Gary McIntyre, Joseph Muniz, and Nadhem AlFardan

2. Designing and Building Security Operations Center, 2015, Book by David Nathans

3. Security Operations Center - SIEM Use Cases and Cyber Threat Intelligence, 2018, Book by Arun E Thomas.

4. The Modern Security Operations Center, 2021, Book by Joseph Muniz

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA461	CLOUD AND INFRASTRUCTURE SECURITY	L-T-P-C: 3-0-0-3

Course Objectives

Familiarization of popular cloud platforms, VM creation, Container management, and Kubernetes, Storage management, Database creation, Network management, Access control mechanism in a computing environment, Virtual private cloud, Design and deployment of secure microservice applications, load balancing, Identity management, Homomorphic encryption, VPC Networking, and security.

Course Outcomes

COs	Description
CO1	Understand the architecture and infrastructure of cloud computing in various cloud computing platforms.
CO2	Identify the known threats, risks, vulnerabilities, and privacy issues in the various layers of cloud computing.
CO3	Compare modern security concepts as they are applied to cloud computing.
CO4	Understand the concepts and various methods of secure data management in the cloud.
CO5	Practical application of various modern cloud technologies.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	-	1	-	-
CO2	2	-	-	-	-	3	-	-	-	1	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-

Syllabus

Cloud computing essentials: - Characteristics, service models, deployment models, NIST reference architecture, virtualization, containers, Kubernetes, design of microservices, high availability, Load Balancing in the cloud, cloud storage, and databases, cloud networking and vpc, popular cloud platforms, open-source architectures.

Threats classification and countermeasures: - Infrastructure and host threats, service provider threats, generic threats, threats assessment, CSA Top threats, Virtualization system vulnerabilities, Authentication and authorization techniques for cloud solutions, Protection of application infrastructure, Protecting Data in the Cloud:- Tokenization, Cryptographic key management for data protection, Encryption techniques and applications for cloud computing, homomorphic encryption, Intrusion Detection and Prevention for cloud workloads, security breaches management for cloud computing, Cloud-centric regulatory compliance issues, and mechanisms.

Textbooks / References:

John R. Vacca(Editor), "Cloud Computing Security - Foundations and Challenges" CRC Press, 2017

1. Ronald L. Krutz and Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", Wiley, 2010
2. Chris Dotson "Practical Cloud Security ", O'Reilly,2019
3. Tim Mather, S. Kumaraswamy, and S. Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly Media, 2009.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA462	CYBER SECURITY LAW	L-T-P-C: 3-0-0-3

Course Objectives

Students will learn the cybersecurity laws in India and abroad. A clear introduction to the laws behind data security, breaches, cybercriminal combat, and much more.

Course Outcomes

COs	Description
CO1	Students will understand the history of cybercrime and the laws created.
CO2	Understand the different classes of cyber-crime.
CO3	Knowledge of the IT act.
CO4	Students will gain knowledge of procedures and authorities in India and abroad.
CO5	Gain familiarity with all laws regarding privacy.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	-	-	-	-	-	-	-	-	-	2
C02	3	1	-	2	2	-	-	-	-	-	-	-	-	-	2
CO3	3	1	-	1	2	-	1	-	-	-	-	-	-	-	2
CO4	3	1	-	2	2	-	1	-	-	-	-	-	-	-	2
CO5	3	1	-	2	2	-	1	-	-	-	-	-	-	-	2

Syllabus

Jurisprudence of cyber law, Information Technology Act, 2008, Cybercrimes, history and evolution of cybercrime, unauthorized access crimes, BEC, ATM frauds, online banking frauds, SIM swap frauds, email frauds, lottery frauds, Web defacement, Web Jacking, crimes relating to digital signature.

Penalties under the IT Act, Relevant Offences under the IT Act

Exemption of liability of intermediaries, Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021, due diligence, Procedures & Authorities.

Authorities and their duties; The National Cyber Coordination Centre (NCCC), Cyber and Information Security (C&IS) Division, National Critical Information Infrastructure Protection Centre (NCIIPC), National Technical Research Organisation (NTRO)

Law of Privacy,GDPR and the EU.

Textbooks / References:

1. Satish Chandra, "Cyberlaw in India".
2. Nilakshi Jain, Ramesh Menon "Cybersecurity and Cyber laws" Wiley media.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course Objectives

The students will be exposed to the fundamentals of machine learning: classification, regression, supervised and unsupervised learning. They will learn which algorithms to use in which context, including model validation and evaluation. They will be exposed to a thorough survey of the fundamental security applications that machine learning provides as well the current security limitations of machine learning.

Course Outcomes

COs	Description
CO1	Learn and understand what machine learning and artificial intelligence.
CO2	Gain proficiency in scikit-learn, using supervised and unsupervised learning.
CO3	Learn the fundamentals of regression and classification.
CO4	Make use of classification and anomaly detection systems in security – fraud and spam detection.
CO5	Learn to threat model for machine learning, understanding adversarial attacks.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2												
CO2	1	3	1										1		
CO3	3	1											1		
CO4	2	3	3		1								1		
CO5	2	2	3										1		

Syllabus

Python, Jupyter Notebooks, Pandas, Numpy, Matplotlib, Seaborn, Scikit-Learn. Supervised learning: Linear regression, Decision Trees, Support Vector Machines, K-nearest neighbors, random forests, AdaBoost, gradient boosting, multi-layer perceptrons, logistic regression. Unsupervised learning: k-means clustering, dbscan, GMM, PCA, T-SNE. Bias-variance tradeoff. Learning and validation curves. Cross-validation, shuffle split, k-fold, time-series split. Random seeds. Baseline and benchmarking models. Gradient descent, regularization, feature scaling, one-hot encoding, label encoding. Train-test-split. Metrics: accuracy, f1-score, precision, recall, confusion matrices. Gini impurity, information gain ratio, feature ranking with multivariate and univariate methods. Hyper-parameter tuning with grid search and random search. Natural language processing, ngrams, bag of words, vectorizers. Data wrangling with feature preprocessing and EDA.

Artificial Intelligence (AI), Deep Learning (DL), and Machine learning (ML) in security. Understand the role AI plays in making decisions in large-scale settings. Algorithm bias and fraud.

Machine learning for security - anomaly detection, fraud detection, malware detection, spam detection, phishing detection, IDS, and NIDS.

Security of machine learning: adversarial attacks on machine learning. Data poisoning, model stealing, evasion attacks at inference time. Adversarial hardening.

Textbooks / References:
1. Tom M Mitchell, Machine Learning, McGraw Hill, 1997
2. Jake Vanderplas, Python Data Science Handbook, O'Reilly Media, 2016
3. Clarence Chio, David Freeman, Machine Learning and Security, O'Reilly Media, 2018

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA464	MOBILE SECURITY AND DEFENSE	L-T-P-C: 3-0-0-3

Course Objectives

The students will learn the fundamental of mobile security and defense. Focus on android platform using android framework and APIs. Students will learn the structure of android applications, the exploits involved and common hardening techniques. Students will learn to perform static and dynamic analysis to identify malicious apps.

Course Outcomes

COs	Description
CO1	Understand internals of Android Operating System, security model of Android and iOS.
CO2	Understand how to make use of relevant tools to inspect and understand the working of Android and iOS application.
CO3	Learn how to identify vulnerable codebase and insecure configuration of application components.
CO4	Learn how to reverse engineer and perform advanced static and dynamic analysis.
CO5	Gain proficiency in identifying Android malware.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	2	1	-	1	-	-	-	-	-	-	-	3
C02	2	1	1	2	3	-	1	-	-	-	-	-	-	-	3
CO3	3	3	3	2	3	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	1	1	1	1	-	-	-	-	-	-	-	3
CO5	3	3	3	3	3	-	2	-	-	-	-	-	-	-	3

Syllabus

History of Smartphones, Smartphone Applications and Development Ecosystem, Android Architecture, Syscalls, IPC mechanism in Android, Android Framework and APIs - APK, App Signing, Java/Dalvik Byte code, Android Run-Time, Reflection, Dynamic Code Loading, Serialization.

Android Apps Overview - Java, Kotlin, Flutter and Android Studio, Activities and Intents - Life cycle, State and Architecture (Eg: MVVM), Broadcast Receiver, Content Provider, Services, Room Database and Shared Preference, Android emulator, AVD, ADB, SSL Pinning.

Static Analysis - Assets and resources, Android Manifest, Native Code, Reverse engineering – apktool, jadx, Android App Bundles (AAB).

Android System Security – Google Services, Android OS and Kernel, Device hardware, Android Malware – Stalkerware, Spyware, Adware. Vulnerabilities and Attack surfaces, Dynamic Analysis – Frida, Proxying Android traffic, Intercepting traffic using burp.

Textbooks / References:

1. Joshua J. Drake, Pau Oliva Fora, Zach Lanier, Collin Mulliner, Stephen A. Ridley, Georg Wicherski - "Android™ Hacker's Handbook" 2014

2. Keith Makan - "Android Security Cookbook", ISBN - 978-1782167167, December 2013

3. Dominic Chell, Tyrone Erasmus, Shaun Colley, Ollie Whitehouse - "The Mobile Application Hacker's Handbook", ISBN: 978-1-118-95850-6, February 2015

4. Nikolay Elenkov - "Android Security Internals: An In-Depth Guide to Android's Security Architecture", ISBN - 978-1593275815, 2014

5. Jonathan Levin, "Android Internals - A Confectioner's Cookbook - Power User's View - 1st edition", ISBN - 978-0991055524, January 2015

6. Mobile Systems and Smartphone Security course (MOBISEC), Fall 2020 at EUROCOM

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24CSA465	**CYBER FORENSICS**	L-T-P-C: 3-0-0-3

Course Description

After completion of the course the students will be able to learn investigation tools and techniques, analysis of data to identify evidence, Technical Aspects & Legal Aspects related to cybercrime.

Course Objectives

Students will learn an introduction to cyber forensics with investigation tools. They will be able to perform evidence collection, preservation, and data recovery. All platforms: Windows, Linux, iOS, Android will be covered. Cyber laws in India and case studies to illuminate.

Course Outcomes

COs	Description
CO1	Exploring Cyber Forensic Investigation, Investigation Tools, Digital Evidence Collection, Evidence Preservation, Data Recovery, Encryption and Decryption methods.
CO2	Familiarizing with Hardware Forensics - Disk, SSD, Memory and Mobile Forensics.
CO3	Exploring the Host/OS (MS Windows, Linux, Android and iOS) Forensics and related File System Forensics.
CO4	Understanding Database Forensics, E-Mail Forensics, Browser Forensics, Dark Web Forensics and Anti-forensics, Exploring Network, Wireless, Cloud and IoT Forensics.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	1				1					
CO2	3	1	1	1	3								1		1
CO3	2	1		1	2					1				1	1
CO4	2	1		1	2								1		

Syllabus

Unit I

Introduction to Cyber Forensic Investigation, Investigation Tools, Digital Evidence Collection, Evidence Preservation, Data Recovery, Encryption and Decryption methods.

Unit II

Search and Seizure of Computers and devices, Recovering deleted evidences, Password Cracking, Security Standards, Cyber Laws and Legal Frameworks, Cyber laws in India, Case studies and tools. ,Hardware/SSD/Device Forensics.

Unit III

File System Forensics, OS Forensics (Windows, Linux, Android and iOS), Memory Forensics, Web/Browser Forensics, Dark Web/Tor Forensics, E-Mail Forensics, Mobile/Wireless Forensics, Network and Communication Forensics, Anti-forensics, Steganography, and Image File Forensics.

Unit IV

IOT Forensics, Cloud Forensics, Overwriting/Forging/Wiping/Destruction, Obfuscation, Online Anonymity and Rootkits. Assessing Threat Levels, Operating System Attacks, Malware Analysis, Financial Frauds, Espionage and Investigations, Investigating copiers, IVR, Video surveillance, RFID and Sim cards.

Textbooks / References:

1. File System Forensic Analysis by Brain Carrier ISBN: 978-0-32-126817-2
2. Incident Response and Computer Forensics, Third Edition by Jason T Luttgens, Mathew Pepe ISBN: 978-0-07-179869-3
3. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software by Michael Sikorski, Andrew Honig ISBN: 978-1-59327-290-6
4. Android Forensics: Investigation, Analysis and Mobile Security for Google Android by Andrew Hoog, ISBN: 978-1-59749-651-3
5. iPhone and iOS Forensics: Investigation, Analysis and Mobile Security for Apple iPhone, iPad, and iOS Devices by Andrew Hoog, Katie Strzempka ISBN: 978-1-59749-659-9.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

Course Objectives

Students will learn introduction to threats, vulnerabilities and breaches in databases. They will be made familiar with the OWASP10 vulnerabilities and common hardening techniques. This is a database first course that focuses on securing them.

Course Outcome

COs	Description
CO1	Understand database security concepts.
CO2	Learn DB access control mechanisms.
CO3	Understand web applications security concepts.
CO4	Learn OWASP Top 10 Vulnerabilities.
CO5	Learn application security and penetration testing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											1		1
C02	3	1	1		2										
CO3	3	2													
CO4	1														
CO5	2	3	2		3									1	

Syllabus

Unit I

Database security – Introduction includes threats, vulnerabilities and breaches, Basics of secure database design, DB security – concepts, approaches and challenges, types of access controls, Oracle VPD, Discretionary and Mandatory access control – Principles, applications and poly-instantiation, Database inference problem, types of inference attacks, distributed database, security levels. Role-based access control (RBAC). Application workflow and DB security;.

Unit II

SQL-injection: types and advanced concepts. Security in relational data model, concurrency controls and locking, SQL extensions to security (oracle as an example), System R concepts, Context and control based access control, Hippocratic databases, Database intrusion, Secure data outsourcing; NIST considerations for secure DB design.

Unit III

Web application security, Basic principles and concepts, Authentication, Authorization, Browser security principles; XSS and CSRF, same origin policies, File security principles, Secure development and deployment methodologies, Web DB principles, OWASP – Top 10 - Detailed treatment, IoT security – OWASP Top 10 – Detailed treatment, OWASP -WEB, SAST, DAST, RASP.

Unit IV

Application security – Concepts, Architecture, CIA Triad, Hexad, types of cyberattacks, Introduction to software development vulnerabilities, code analyzers – Static and dynamic analyzers, Static application security testing (SAST), Dynamic application security testing (DAST), Runtime Application Self-Protection (RASP) security, Architectural reviews.

Unit V

Security testing / Penetration testing – Principles and concepts, PT workflows and examples, blind tests, SDLC phases and security mandates.

Cloud application security – concepts and architecture (AWS example); security consideration for cloud migrations. RDW Security and compliance.

Textbooks / References:

1. Michael Gertz and Sushil Jajodia, "Handbook of Database Security— Applications and Trends", Springer, 2008.
2. Bhavani Thuraisingham, "Database and Applications Security", Integrating Information Security and Data Management, Auerbach Publications, 2005.
3. Alfred Basta, Melissa Zgola, "Database Security", Course Technology, 2012.
4. Database and Application Security XV (IFIP International Federation For Information Processing) by Martin S. Olivier, 2001
5. Web application security – Exploitation and countermeasures for modern web applications, OReilly.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

CourseObjective(s)

- Understand the foundational ethical theories, including utilitarianism, deontology, and virtue ethics, and apply them to analyze ethical considerations in handling personal and sensitive data.
- Analyze the ethical implications of various data collection methods, such as surveillance and data mining, and assess the privacy concerns arising from data processing techniques like profiling and data analytics.
- Examine the legal and regulatory frameworks governing data privacy, including international and national data protection laws, and evaluate the compliance requirements for organizations handling personal data.
- Develop ethical decision-making skills in data-driven environments by exploring ethical frameworks for decision making in data science and analytics and assessing the ethical implications of artificial intelligence and machine learning technologies.

CourseOutcomes

COs	Description
CO1	Understand ethical theories such as utilitarianism, deontology, and virtue ethics.
CO2	Evaluate the ethical implications of various data collection methods like surveillance and data mining.
CO3	Apply ethical frameworks to guide decision-making in data science and analytics.
CO4	Recognize the importance of ethics and corporate social responsibility in data-driven organizations.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	2	-	-	-	-	-	-
CO2	3	3	-	-	-	2	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	-	3	2	-	-	-	-	-	-	-

Syllabus

Unit-1: Introduction to Ethics and Data Privacy:Overview of ethical theories -utilitarianism, deontology, virtue ethics, Introduction to data privacy concepts and regulations-GDPR, CCPA, Ethical considerations in handling personal and sensitive data.

Unit: 2: Ethical Issues in Data Collection and Processing:

Ethical implications of data collection methods-surveillance, data mining, Privacy concerns in data processing-profiling, data analytics.

Legal and Regulatory Frameworks: Overview of international and national data protection laws, Compliance requirements for organizations handling personal data.

Unit 3: Ethical Decision Making in Data-Driven Environments and Privacy Engacing Practices:

Ethical frameworks for decision making in data science and analytics, Ethical considerations in algorithm development and deployment Ethical implications of artificial intelligence and machine learning technologies.

Privacy-Enhancing Technologies and Practices- Overview of privacy-enhancing technologies (PETs), Best practices for implementing privacy-by-design principles

Unit 4: Ethical Leadership,CorporateResponsibility,Emerging Issues and Future Trends: Role of ethics and corporate social responsibility (CSR) in data-driven organizations, Ethical leadership in promoting transparency, accountability, and

trust. Exploration of emerging ethical issues in data privacy in IoT and biometrics, Ethical considerations in the era of big data, IoT, and ubiquitous computing.

Textbook

1. "Ethics for the Information Age" by Michael J. Quinn
2. "Data and Goliath: The Hidden Battles to Collect Your Data and Control Your World" by Bruce Schneier
3. "Privacy in Context: Technology, Policy, and the Integrity of Social Life" by Helen Nissenbaum

Reference

1. "Privacy on the Ground: Driving Corporate Behavior in the United States and Europe" by Kenneth A. Bamberger and Deirdre K. Mulligan
2. "The Ethics of Information Technology and Business" edited by Richard T. De George and Joseph R. Varner
3. "Privacy in the Age of Big Data: Recognizing Threats, Defending Your Rights, and Protecting Your Family" by Theresa M. Payton and Ted Claypoole

EvaluationPattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24OEL341	INTRODUCTION TO BIG DATA AND CLOUD	L-T-P-C: 3-0-0-3

Course Objectives
1. To understand the need of a framework to store and process the big data.
2. To have knowledge on the Big Data Technologies for processing the Different types of Data
3. To understand the basic Knowledge about Cloud Computing.
4. To understand the frame work for faster accessing and processing of Cloud computing.

Course Outcomes

COs	Description
CO1	To understand the fundamentals of big data and its analytics.
CO2	To learn about different big data technologies and tools.
CO3	To gain knowledge of cloud computing concepts and services.
CO4	To explore the integration of big data analytics on the cloud.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	3	-	-	-	3	2	-	-	-	-	-	-	2	-	3
CO3	3	-	-	-	3	2	2	-	2	-	-	-	3	-	3
CO4	3	2	-	1	1	1	1	-	2	-	-	-	-	-	3

Syllabus

Unit I

Understanding Big Data: Concepts and terminology, Big Data Characteristics, Different types of Data, Big Data Architecture - Big Data Storage: File system and Distributed File System, NoSQL, Sharding and Replication, ACID and BASE Properties

Unit II

Big Data Technologies: Hadoop Ecosystem: HDFS, MapReduce, Introduction to Apache Spark, NoSQL Databases: MongoDB, Cassandra, Data Warehousing Solutions: Hive, HBase.

Unit III

Introduction to Cloud Computing: Characteristics of Cloud Computing, Cloud Service Models: IaaS, PaaS, SaaS, Cloud Deployment Models, Benefits and Challenges of Cloud Computing. Overview of Major Cloud Service Providers: AWS, Azure, Google Cloud.

Cloud Services Overview: Compute, Storage, Databases, Networking, Introduction to Virtualization and Containers: Docker, Kubernetes

Unit IV

Big Data Analytics on the Cloud: Cloud-based Big Data Services: Amazon EMR, Google Big Query, Azure HDInsight, Case Studies: Real-world applications of Big Data Analytics on the Cloud, Cost and Performance Considerations.

Security Challenges, Future Trends in Cloud Computing.

Textbooks / References:
1. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers &Techniques, Pearson India Education Service Pvt. Ltd., First Edition, 2016.
2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Inc., Fourth Edition, 2015.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24OEL342	BASICS OF PROGRAMMING USING PYTHON	L-T-P-C: 3-0-0-3

Course Objectives

- The main objective of this course is to familiarize the student with programming concepts using Python programming, the syntax, semantics, the runtime environment, and the techniques for data visualization.

Course Outcomes

COs	Description
CO1	Understand the structure, syntax, and semantics of the Python language.
CO2	Understand the loops and decision statements in Python.
CO3	Understand lists, tuples, and dictionaries in Python programs.
CO4	Explain user defined functions and to read from and write to files in Python.
CO5	Explore different Python packages of data analysis for real-world problems.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-

Syllabus
Unit I
Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc.
Unit II
Python Program: Flow Control-Conditional blocks: if, else and else if, Looping- Simple for loops in python, For loop using ranges, Use of while loops, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.
Unit III
Python Complex data types: String- Using string in-built functions and string operations, List-list slicing, functions and methods in list, and List manipulation. Tuples – functions and methods in tuple. Dictionary-Functions and methods in dictionary, dictionary manipulations Iterators and iterables
Unit IV
Python Functions, organizing python codes using functions, File Handling-Read, Write, Create and Delete
Unit V
Demonstration: The Numerical Python Library (NumPy), Pandas. The Series Data Structure, Querying a Series, Pandas - Data frames, Data visualization using Matplotlib
Textbooks/References
1. Yashavant kanetkar, Aditya Kanetkar,"Let us Python",3rd Edition,bpb publication
2. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition , Pearson Education, 2016
3. Mark Lutz, "Learning Python", 5th edition, O'Reilly Publication, 2013.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

24OEL343	**DATA ANALYTICS AND VISUALIZATION**	**L-T-P-C: 3-0-0-3**

Course Objectives

To make the students learn the process of working with data in large scale. Make the student understand the existence of data with its wilderness and make use of it.

Course Outcomes

CO1	Explore the fundamental concepts of data analytics.
CO2	Recognize and conduct statistical inference to solve engineering problems.
CO3	Get insights into different data visualization techniques and standard tools
CO4	Develop the skillset to build effective solutions for Big Data issues using Power BI and its Eco-System
CO5	Master the basics of Power BI

CO-PO MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2		-	-	-	-	-	-	-	-	-	2	2	-
CO3	2			-	-	-	-	-	-	-	-	-	-	1	-
CO4	1	2	1	1	1	-	1	-	-	-	-	-	2	1	-
CO5	1	2	1	1	2	-	1	-	-		-	-	2	1	-

Syllabus

UNIT 1 Introduction to Data Analytics

Evolution of Data Analytics, Data Analytics Overview, Types of Data Analytics -Descriptive Analytics -Diagnostic Analytics -Predictive Analytics -Prescriptive Analytics, Importance and Benefits of Data Analytics. Different Applications of Analytics in Business, Text Analytics and Web Analytics, Skills for Business Analytics.

UNIT 2 Data analysis

Introduction to elementary data analysis: Measures of center: Mean, Median, Mode, Variance,

Standard deviation, Range, Normal Distribution :Center, Spread, Skewed Left, Skewed Right,Outlier, Correlation Patterns, Magnitude and Direction in relationship, Introduction to BayesianMode

UNIT 3 Introduction to Data Visualization

History of Visualization, Goals of Visualization, Types of Data Visualization: Scientific

Visualization, Information Visualization, Visual Analytics, Impact of visualization, Big DataVisualization Tools: Tableau, Google Chart

UNIT 4

Visualization foundations, Introduction to Power BI, Power BI – Advantages and Scalable Options, Power BI Architecture and Data Access.

UNIT 5

Visualization Techniques for Spatial Data, Geospatial Data, Time-Oriented Data, Multivariate Data, Trees, Graphs, and Networks, Text and Document Visualization.

Power Query & M Language.

TEXTBOOKS:
1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics", Wiley, 2015
2. Kumar, U.D. :Business Analytics – The Science of Data – Driven Decision Making, Wiley.
3. 2. Dr Anil Maheshwari, Data Analytics Made Accessible, Publisher: Amazon.com Services LLC Ivan Bayross:

REFERENCE:
1. Data Analytics: Principles, Tools, and Practices: A Complete Guide for Advanced Data Analytics Using the Latest Trends, Tools, and Technologies by Dr. Gaurav Aroraa (Author), Chitra Lele (Author), Dr. Munish Jindal (Author)

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)

- The course teaches students basics of cyber security concepts, understand cyber-attacks, familiarize with different types of cryptosystem, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.

Course Outcomes

COs	Description
CO1	Understand the concept of Cyber security and issues and challenges associated with it.
CO2	Grasping the essential principles and methods behind currently used cryptographic algorithms.
CO3	Understand the different network defence tools .
CO4	Understand the cyber crimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures.
CO5	understand knowledge of the Indian crime and IT act

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	1	-	-	2	-	-	1
CO2	3	2	-	-	-	-	-	-	1	-	-	1	-	-	
CO3	3	2	-	-	1	-	-	-	-	-	-	1	-	-	
CO4	2	3	1	-	-	-	-	-	-	-	-	-	-	-	1
CO5	2	2	1	-	-	-	-	-	-	-	-	1	-	-	1

Syllabus

Unit I

Introduction to Cyber Security: Introduction, Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control

Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

Unit II

Cryptography in Practice - Historical Perspectives - A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography , Hashing Functions Symmetric Encryption , Asymmetric Encryption -, Cryptography Algorithm Use.

Unit III

Network Defense tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding.VPN:the basic of Virtual Private Networks.

Unit IV

Introduction to Cyber Crime, law and Investigation: Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime,Realms of the Cyber world.

Unit V

Internet crime and Act: A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.

Textbooks

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
3. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
4. William Stallings, Cryptography and Network Security Principles and Practice, 4/e, Pearson Ed.

References

1. Prashant Mali, Cyber Law & Cyber Crimes Simplified, Fourth Edition, Snow White Publications, 2017.
2. Vakul Sharma, Information Technology - Law and Practice (Law and Emerging Technology, Cyber Law & E-Commerce), Sixth Edition, Universal Law Publishing Co. (ULPC), 2018.
3. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL345	THE ART OF CRYPTOGRAPHY	L-T-P-C: 3-0-0-3

Course Objectives: The main objective of this course is to introduce the working of various cryptographic methods and how to apply this knowledge to real-world applications. This course will also present an overview of Cyber Security.

Course Outcomes

CO1	Introduces the need of security and various encryption techniques
CO2	Understand the concepts of confidentiality, integrity, and authenticity in cryptography
CO3	Learn about different types of encryption algorithms and their strengths and weaknesses
CO4	Understand the digital signature standards and its application in real world
CO5	Able to provide confidentiality and integrity to the messages

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	-	1	-	-	2	-	-	1
CO2	3	2	3	-	-	-	-	-	1	-	-	1	-	-	
CO3	2	2	3	-	1	-	-	-	-	-	-	1	-	-	
CO4	3	2	3	-	-	-	-	-	-	-	-	-	-	-	1
CO5	2	2	3	-	-	-	-	-	-	-	-	1	-	-	1

Syllabus

UNIT 1: Introduction to Cryptography - History of cryptography - Basic concepts: confidentiality, integrity, authenticity and Security models: CIA/STAR - Types of attacks: passive, active, and side-channel attacks

UNIT 2: Classical Cryptographic Techniques-substitution ciphers and transposition ciphers

UNIT 3: Modern Cryptography - Block Ciphers: DES, AES - Stream Ciphers: RC4, FISH -Public-Key Cryptography: RSA - Digital Signature Standards

UNIT 4: Cryptanalysis and Cryptanalysis Techniques - Brute Force Attack -Frequency Analysis- Differential Cryptanalysis - Side-Channel Attacks

UNIT 5: Applications of Cryptography - Secure Communication Protocols: SSL/TLS, IPsec - Digital Certificates and Public Key Infrastructure - Cryptography in Practice: Secure Email, Secure Web Browsing

Textbooks/References:

- *"Cryptography: Theory and Practice" by Douglas Stinson*
- *"Introduction to Cryptography" by Bruce Schneier*
- *William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson Education, Sixth Edition.*
- *Nina Godbole and SunitBelpure, Cyber Security: Understanding Cyber crimes, ComputerForeinsics and Legal Perspectives, Willey India Pvt.Ltd.*
- *Dr T R Padmanabhan N Harini,"Cryptography and Security Paperback", Wiley India*

Evaluation Criteria

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)
1. To provide an understanding of the the evolution and driving forces behind IoT.
2. To provide the understanding of the core concepts of Internet of Things (IoT.
3. To provide insights into the future trends and advancements in the IoT landscape

Course Outcomes

COs	Description
CO1	Describe the fundamental principles and architecture of IoT
CO2	Identify various IoT components, including sensors, actuators, communication protocols, and data management platforms
CO3	Explore the various communication technologies used and data security considerations in IoT systems
CO4	Explore different application domains of IoT and their impact

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	-	1	-
CO4	1	1	3	-	-	-	-	-	-	-	-	1	-	1	-

Syllabus
Unit I
Introduction to IoT: Definition, characteristics, benefits, and challenges.
Evolution of IoT: From Machine-to-Machine (M2M) communication to the present.
Applications of IoT: Smart cities, smart homes, wearables, industrial IoT, and connected healthcare.
IoT architecture
Unit II
Building Blocks of IoT:
IoT components: Sensors (types and functionalities), actuators (types and functionalities), communication protocols (Wi-Fi, Bluetooth, LoRaWAN, cellular networks).
Data management platforms: Cloud platforms for IoT data storage, processing, and analytics.
Unit III
Connectivity and Data Management:
Network connectivity solutions for IoT: Short-range (Bluetooth, Wi-Fi), long-range (cellular networks, satellite), and low-power wide-area networks (LPWAN).
Data management in IoT: Data collection, storage, processing, and analysis.
Data security in IoT: Vulnerabilities, authentication, authorization, and encryption techniques.
Unit IV
Case studies: Exploring successful IoT applications in smart cities, smart homes, wearables, industrial IoT, and connected healthcare.
Impact of IoT: Social, economic, and environmental considerations.
Future trends in IoT.
Textbooks/
1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press, First Edition.
2. Raj Kamal, INTERNET OF THINGS (IOT): Architecture and Design Principles, Standard Edition, McGrawhill

References
1. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley, Second Edition
2. Vibha Soni, IoT for Beginners: Explore IoT Architecture, Working Principles, IoT Devices, and Various Real IoT Projects, BPB Publications.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL347	**INTRODUCTION TO AI**	**L-T-P-C: 3-0-0-3**

Course Objective(s)
1. To provide an understanding of the fundamental concepts of Artificial Intelligence
2. To provide the understanding of how machine learning can be applied to various real world applications.
3. To provide insight into applications of AI in various disciplines.

Course Outcomes

COs	Description
CO1	Describe the key concepts of AI
CO2	Explain machine learning concepts
CO3	Discuss about neural networks and its variants
CO4	Discuss about Text processing and language models
CO5	Discuss about applications of AI in various fields

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	1	-	-	-	-	-

Syllabus
Unit I
Introduction to AI- History and evolution, Key concepts and defenitions, overview of Machine learning, neural networks, natural language processing

Unit II
Machine Learning Fundamentals: Supervised vs. unsupervised learning, Regression, classification, and clustering, Evaluation metrics and model validation

Unit III
Basics of neural networks: Introduction to deep learning: CNNs, RNNs, Applications in image and speech recognition

Unit IV
Natural Language Processing (NLP): Text preprocessing and representation, Language models and transformers, Applications in text generation, sentiment analysis, and machine translation

Unit V
AI in Healthcare and Biology: AI applications in medical imaging, diagnostics, and personalized medicine, Machine learning for genomics and drug discovery. AI in Social Sciences and Humanities: AI in economics: predictive analytics, market analysis, AI in psychology: behavioral modeling, cognitive simulations, Ethical and societal implications of AI

References
1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. Pattern Recognition and Machine Learning" by Christopher Bishop.
3. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
4. Speech and Language Processing" by Daniel Jurafsky and James H. Martin.
5. The Ethics of Artificial Intelligence" by Nick Bostrom and Eliezer Yudkowsky

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

Course Objective(s)
1. To provide an understanding of the fundamental concepts, techniques, and tools used in front-end web development..
2. To create interactive, visually appealing web pages using HTML, CSS, and JavaScript.
3. To provide an Introduction to Front-End Frameworks.

Course Outcomes

COs	Description
CO1	Explain the structure of a web page and how to manipulate it using HTML
CO2	Design about Style web pages using CSS to create visually engaging content
CO3	Discuss about the use of JavaScript to add interactivity to web pages.
CO4	Discuss about the use of modern front-end frameworks and tools.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-		-	3	-	-	-	-	-	-	-		-	-
CO2	1	-	1	-	2	-	-	-	-	-	-	-	2	-	-
CO3	1	-	1	-	1	-	-	-	-	-	-	-	2	-	-
CO4	1	-	1	-	1	-	-	-	-	-	-	-	1	-	-

Syllabus
Unit I
Introduction To Web: Client/Server concepts, Components of Web Application, Types of Web Content, Overview of HTTP - HTTP request – response, Generation of dynamic web pages, Application Servers, Web Security.
Markup Language (HTML): Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames, HTML Forms.
Unit II
Cascading Style Sheet (CSS): The need for CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style Sheets, Backgrounds, Manipulating text, Margins and Padding, Positioning using CSS.
Unit III
Client Side Scripting using JavaScript: Core features, Data types and Variables, Operators -Expressions and Statements, Functions, Objects, Array, String - Date and Math related Objects, Document Object Model, Event Handling, Form handling and validations.
Unit IV
Web Development Tools and Workflow:Version Control with Git and GitHub,Introduction to Webpack and build tools,Package Managers: npm and yarn.Introduction to Front-End Frameworks:Overview of front-end frameworks: React, Angular

Textbooks
1. Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", 5th Edition, Pearson Education
2. David Flanagan, "JavaScript: The Definitive Guide", 6th Edition", O'Reilly Media

References
1. Douglas E Comer, "The Internet Book: Everything You Need to Know About Computer Networking and How the Internet Works", 4th Edition, Prentice Hall Jon Duckett, HTML and CSS: Design and Build Websites
2. Jennifer Kyrnin, "HTML , CSS and javascript all in one"
3. Haverbeke, Eloquent JavaScript: A Modern Introduction to Programming"

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL349	**GENERATIVE AI FOR EVERYONE**	**L-T-P-C: 3-0-0-3**

Course Objective(s)

This course provides a comprehensive introduction to generative artificial intelligence (AI). It covers the fundamental concepts, practical applications, and ethical considerations of generative AI, making the field accessible to all participants regardless of their technical background.

Course Outcomes

COs	Description
CO1	Understand the basics of generative AI and its key concepts.
CO2	Explore various types of generative models and their applications.
CO3	Gain hands-on experience with generative AI tools and platforms.
CO4	Discuss the ethical and societal implications of generative AI.
CO5	Discuss the latest trends and future directions in generative AI.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO2	2	1	2	-	1	-	-	-	-	-	-	1	-	-	-
CO3	2	1	3	1	-	-	-	-	-	-	-	1	-	-	-
CO4	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	-	1	-	-	-	-	-	-	-	-	1	-

Syllabus

Unit 1

Understanding Generative AI- Introduction to AI and machine learning - Definition and history of generative AI - How generative AI differs from traditional AI - Basic concepts: data generation, creativity, and synthesis - Examples of generative AI in everyday life – Working of GenAI

Unit 2

Generative Models – Types – LLMs - Generative Adversarial Networks (GANs) – introduction – working: generator and discriminator - applications of GANs in image and video generation - Variational Autoencoders (VAEs), and transformers - introduction – working: encoding and decoding - applications of VAEs in data compression and generation - Transformer Models – introduction - working: attention mechanisms - applications of transformers in text generation (e.g., GPT models)

Unit 3

ChatGPT: A Practical Application of GPT - Introduction to ChatGPT and its purpose - Training data and techniques for ChatGPT - Handling user queries and generating responses - Tips for improving ChatGPT's performance.

Unit 4

Ethical Considerations - Understanding the ethical implications of generative models - Addressing bias and fairness in generative AI systems - Ensuring responsible use and deployment of generative model.

Unit 5

Use Cases of Generative AI - Overview of various domains and industries benefiting from Generative AI - Use cases in natural language processing, content generation, and creative applications - Case studies highlighting successful implementations - Potential future applications and emerging trends.

Textbooks / References

1. "AI for Beginners: The Ultimate Guide to Mastering Generative Intelligence, From Theory to Practice". by Alan Miller
2. "Generative AI in Practice" by Bernard Marr

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL350	INTRODUCTION TO RELATIONAL DATABASE	L-T-P-C: 3-0-0-3

Course Objectives
- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Outcomes

CO1	Master the basic concepts of DBMS like data independence and three schema architecture.
CO2	Be familiar with the CODD's rules and E-R Model and also have clear picture about the structure of the relational databases.
CO3	Master the concept of normalization and different types of normalization.
CO4	Be familiar with the basics of query evaluation techniques and query optimization and also to get a clear picture about transaction processing.
CO5	Master the basics of SQL and construct queries using SQL.

CO-PO MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-

Syllabus
UNIT 1
Introduction - Data Independence - The Three Levels Of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure , Instance and schema, Data Models, Types of DBMS
UNIT 2
Keys - CODD's Rules, Design Issues -ER – Model –Attribute types- Weak Entity Sets - Extended ER Features –ER to Relational Mapping, Structure Of Relational Databases
UNIT 3
Normalization –Anomalies- Functional Dependency: Armstrong's axioms- closure of a relation and closure of attribute– Lossless decomposition-1NF, 2NF, 3NF, Boyce - Codd Normal Form
UNIT 4
The Relational Algebra -- Query Processing and Optimization: Evaluation of Relational algebra expressions-Query Equivalence-Transaction Processing: ACID properties, states of a transaction.
UNIT 5
Built in SQL functions- Set operations, Sub Queries-Joins-DCL – TCL- Views.
TEXTBOOKS:
1. Silberschatz. Korth. Sudarshan: Database System Concepts - 6thEdition Mcgraw-Hill International Edition
2. Ivan Bayross: Sql- PL/SQL The Programming Language Of Oracle- 4rd Edition- Bpb Publications
REFERENCE:
1. C.J. Date: An Introduction To Database Systems - Eighth Edition - Pearson Education Asia .
2. Kevin Loney - George Koch: Oracle 9i The Complete Reference Mcgraw-Hill International Edition.
3. "Fundamentals of Database Systems" by Elmasri and Navathe .
Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL351	**NETWORKING FOUNDATIONS**	**L-T-P-C: 3-0-0-3**

Course Description

The main objective of this course is to introduce the fundamental concepts and technologies of computer networking. Students will learn about the architecture, protocols, and devices that make up a network, as well as the principles of network design and troubleshooting.

Course Objectives:

CO1	Understand the fundamental concepts of computer networking
CO2	Learn about the architecture and protocols of the Internet
CO3	Understand the importance of different network devices
CO4	Understand the principles of network design and troubleshooting
CO5	Apply networking concepts to solve real-world problems

CO-PO MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3								1			
CO2	1	2	2	1									1		
CO3	2	1	2	2											
CO4	1	2	1	1									1		
CO5	1	2	2	2											

Syllabus

UNIT 1: Introduction to Networking - ARPANET - Overview of computer networking - Network architecture: LAN, WAN, MAN, Topology – Star, Ring, Bus, Tree, Mesh

UNIT 2: Network Protocols - TCP/IP protocol suite - IPv4 and IPv6 address formats - DNS and DHCP protocols - HTTP and FTP protocols

UNIT 3: Network Devices: modem, hub, switches, repeaters, routers, firewalls -Network cable types: twisted pair, co-axial, fiber optic

UNIT 4: Network Design and Troubleshooting - Network design principles: scalability, reliability, security - Network troubleshooting techniques: ping, traceroute, Wireshark

UNIT 5: Network security: firewalls, VPNs, encryption, Network virtualization - virtual routers, virtual switches, Network management: SNMP, RMON

Textbooks / References:
- "Computer Networks" by Andrew S. Tanenbaum and David J. Wetherall
- "Networking Essentials" by Cisco Press

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL352	**DATA ANALYSIS USING MS EXCEL**	**L-T-P-C: 3-0-0-3**

Course Objective(s)
1. To develop the Data Processing skill in MS Excel
2. To develop the Data Analysis and Data Visualization skill

Course Outcomes

COs	Description
CO1	Understand the basic components of MS Excel and its functionality
CO2	Understand various functions and formulae used in data analysis
CO3	Understand various charts used in MS Excel
CO4	Apply data analysis tools like pivot table, goal seek, scenarios etc
CO5	Apply data analysis tools to perform statistical analysis

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	-	-	-	1	-	-	1	-	-	1
CO2	1	1	-	-	-	-	-	-	1	-	-	1	-	-	1
CO3	-	2	-	-	-	-	-	-	-	-	-	1	-	-	1
CO4	-	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO5	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1

Syllabus

Unit I

Spreadsheets basics, Need for Spreadsheets, Work-Book, Work –Sheet, Parts of a MSExcel Work-Sheet- Program area, Work area, Contents of Ribbons, Meaning of Cell- Cell address, Formula-Bar, RowNumbers, Column-Letters, Quick Access to Tool-Bar, Office Button, Floating Frames, Adding Work-Sheets in Sheet Tab, Status- Bar., and other features ofExcel

Unit II

Functions: - Logical Functions - Date and Time Functions - Information Functions -Math and Trigonometry Functions - Statistical Functions - Text Functions – Sorting: Sorting on single column, sorting on multiple columns, Filtering: Filtering data using AutoFilter

Unit III

Data visualization using Excel-Different types of charts, Creating a chart, Parts of chart, Changing chart type, changing chart options:- Simple Bar Chart – Multiple Bar Chart – Subdivided Bar Chart – Pie Chart – Donut Chart - Line Chart – Histogram – Scatter Plot - Radar Chart – Bubble Chart – BiAxis chart – Plotting Density Function and Distribution Function

Unit IV

Working with PivotTables: Creating a PivotTable, Specifying PivotTable data, Working with PivotTable Layout, Vlookup, Hlookup, - Conditional Formatting - Adding Add-Ins in Excel - Solver – Goal Seek

Unit V

Statistical measures – Mean, Variance, Percentiles, Quatlies - Pearson correlation – Spearman's Rank correlation – Parametric tests – test for single population mean , equality of mean for two independent sample , paired t test, testing correlation coefficient, Non parametric tests – Mann Whitney U test, Wilcoxon signed rank test – Kruskall Wallis test – One way ANOVA – Simple and Multiple Linear regression

Textbooks

1.Microsoft Office 2007 Fundamentals, 1st Edition By Laura Story, Dawna Walls

2.Working in Microsoft Office – Ron Mansfield - TMH

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL353	**R PROGRAMMING**	L-T-P-C: 3-0-0-3

Course Objective(s)
1. To understand the basics in R programming in terms of constructs, control statements, string functions
2. To able to appreciate and apply the R programming from a statistical perspective

Course Outcomes

COs	Description
CO1	Learn the basic syntax of R programming language
CO2	Pre-process raw data in R for further analysis.
CO3	Conduct exploratory data analysis using R
CO4	Create insightful visualizations to identify patterns from data.
CO5	Use statistical estimates to make meaningful predictions from data.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	-	-	-	1	-	-	1	-	-	1
CO2	3	3	2	2	3	2	-	-	1	-	-	1	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-	1
CO4	3	2	3	-	-	-	-	-	-	-	-	-	-	-	1
CO5	3	3	3	3	3	-	-	2	-	-	-	-	-	-	1

Syllabus

Unit I

The R Programming Language- Basic concepts, definitions and notations, R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Getting Data In and Out of R – Vector Equality – Vector Element names

Unit II

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

Unit III

Conditional statements and Control structures, Looping constructs and Loop control statements. Function in R Programming- Components of a Function, Built in and user defined Functions. R -strings and string manipulation functions.

Unit IV

Scoping rules in R, Package in R- Installing and Loading Packages in R, using help, access functions from packages. R for Basic Statistics- Descriptive Statistics: arithmetic mean, median, Measure of dispersion - Minimum and Maximum values, quantiles, percentiles, IQR, standard deviation, variance.

Unit V

Exploring data- Using summary statistics, Visually inspecting data - Histograms and Density plots, Dot Plots, Line Charts, Pie Charts, Boxplots, Scatterplots, saving and exporting results.

R for managing data-Data cleansing, Treating missing values, data transformations, sampling data for modeling- test and training splits, creating sample groups, Data reduction.

Textbooks
1. Norman Mat off, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.
2. Data Science with R: A Step By Step Guide with Visual Illustrations & Examples, Andrew Oleksy.
3. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
4. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015

References
1. "R for Data Science", Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. "Data Mining for Business Analytics: Concepts, Techniques and Applications in R", GalitShmueli, et al, Wiley India, 2018.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

| 24OEL354 | **INTRODUCTION TO CRYPTO CURRENCY AND BLOCKCHAIN** | 3-0-0-3 |

Course Objectives
- To provide insights to crypto currency
- To provide understanding about Blockchain Technology and its applications

Course Outcome

CO1	Introduction to Cryptocurrency
CO2	Familiarizing with Blockchain Technology
CO3	Understanding Bitcoin and Decentralized Applications
CO4	Exploring different applications of Blockchain and understanding future scope

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO2	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO3	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO4	1	1	1	1	1	-	-	-	-	-	-	-	2	-	2

Syllabus
Module 1
Introduction to Crypto Currency-A brief history of Crypto Currency-Traditional currencies VS Crypto Currency-What is Crypto Currency? Working of crypto currency-Benefits of crypto currency-Examples
Module 2
Introduction to Blockchain What is a Blockchain? Do you need a Blockchain? Permission-less vs Permissioned Blockchains, Public vs Private vs Hybrid vs Consortium Blockchains-Blockchain Dementalization-Blockchain Nodes-Disadvantages of current transactions Benefits of Blockchain
Module 3
Decentralized Applications: Cryptocurrencies (Internet of Money) – History, Bitcoin, Ethers & Gas (Ethereum) and Atom (Cosmos), Introduction to Altcoins & Stablecoins, DOT (Polkadot), Ripple, Stellar & IOTA,
Module 4
Applications of Blockchain-Applications of Blockchain in Data Management-Integration of AI and Blockchain-Use cases of Blockchain in different fields-Role of Blockchain in Sustainable Development-Blockchain Security-Future Scope of Blockchain

Textbooks / References:/ REFERENCES:
1. Blockchain Technology by Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan
2. Blockchain Applications – A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti
3. Bitcoin and Cryptocurrency Technologies by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder
4. Mastering Bitcoin by Andreas Antonopoulos

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL355	BASICS OF LINUX OPERATING SYSTEM	L-T-P-C: 3-0-0-3

Course Objective(s)

This course provides a good working knowledge of Linux Operating System using graphical interface and command line interface across various Linux Distributions. This course provides foundational knowledge needed to navigate Linux confidently and perform essential tasks in a command-line environment.

COs	Description
CO1	Navigate the Linux file system and execute essential commands.
CO2	Manage files, directories, and permissions with ease.
CO3	Create and edit text files using various text editors
CO4	Monitor and control processes and understand job control.
CO5	Apply fundamental security practices to safeguard the system.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1	-	1	-	-	-	1	-	-	-	-	-	1
CO2			-	-	1	-	-	-	1	-	-	-	-	-	1
CO3			-	-		-	-	-	-	-	-	-	-	-	1
CO4			1	-	1	-	-	-	-	-	-	-	-	-	1
CO5			1												1

Syllabus

Unit 1

Introduction to Linux - Overview and History - Understanding the origins and significance of Linux - Differentiating between Linux distributions (distros) - Getting Started - Basic system navigation and file structure -Interacting with the shell (command-line interface)

Unit 2

Essential Linux Commands and Utilities - Command-Line Basics -Using commands like `ls`, `cd`, `pwd`, `cp`, `mv`, and `rm`- Managing files and directories-File Permissions and Ownership -Understanding permissions (read, write, execute)-Changing permissions using `chmod`

Unit 3

Text Editors and scripting-Text Editors Introduction to text editors (e.g., `nano`, `vim`)-Creating and editing text files-Shell Scripting Basics -Writing simple shell scripts-Using variables and loops-

Unit 4

Processes, Job Control, and Networking-Managing Processes-Monitoring processes with `ps` and `top`-Background and foreground processes-Networking Essentials -Basic network commands (e.g., `ping`, `ifconfig`, `netstat`)-Connecting to remote servers via SSH

Unit 5

System Configuration and Security -Environment Variables and Profiles-Setting environment variables-Customizing user profiles-Basic Security Practices -User authentication and password management-Securing files and directories-Introduction to firewalls

Textbook/Refrences

1. Linux: A Complete Guide to Learn Linux Commands, Linux Operating System and Shell Scripting Step-by-Step, by Nicholas Ayden,
2. Learn Linux Quickly: A Comprehensive Guide for Getting Up to Speed on the Linux Command Line (Ubuntu), Crawford Press, 20 January 2021
3. A Practical Guide to Linux Commands, Editors, and Shell Programming, Fourth Edition, Mark G. Sobell, Matthew Helmke, November 2017, Pearson
4. Begining Linux Programming, 4th Edition, N. Matthew, R.Stones, Wrox, Wiley India Edition.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

24OEL356   ADMINISTRATION AND AUTOMATION WITH WINDOWS POWERSHELL L-T-P-C: 3-0-0-3

Course Objective(s)

This course will introduce Windows PowerShell and provide an overview of the product's functionality. The module shows how to open and configure the shell for use and how to run commands within the shell. The module also provide how to perform administration tasks and automate the tasks.

COs	Description
CO1	Identify the use of windows powershell for administration
CO2	Run commands by using the correct command and parameter syntax.
CO3	Perform administrative task using windows power shell
CO4	Demonstrate how to automate tasks in windows power shell

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1	-	1	-	-	-	1	-	-	-	-	-	1
CO2			-	-	1	-	-	-	1	-	-	-	-	-	1
CO3			-	-	1	-	-	-	-	-	-	-	-	-	1
CO4			1	-	1	-	-	-	-	-	-	-	-	-	1

Syllabus

Unit I

Introduction to powershell - Understanding its role in system administration –Powershell Versions-Launching PowerShell –Configuring Windows powershell console-Verifying script execution policy settings

Unit II

Powershell basics – Cmdlets:Building block of powershell – Working with variable and operators- managing objects and arrays- using built in help system-Finding commands- Command line fundamentals- Working with Keyboard Shortcuts – running commands

Unit III

Administration with powershell – Active directory administration cmdlets- network configuration cmdlets- other server administration cmdlets

Unit IV

Automating Tasks – Automating common administrative tasks-Scheduling scripts- Registry management- using background jobs

Textbooks/References

1. Michael Shepard, Sherif Talaat, Chendrayan Venkatesan, "PowerShell: Automating Administrative Tasks", Packt Publishing, 2017
2. Craig Berg, Windows Powershell and Scripting Made Easy For Sysadmins: A Comprehensive Beginners Guide To Windows Powershell And Scripting To Automate Tasks And Environment – 2021, Amazon Digital Services LLC - Kdp

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

LAB ELECTIVES

24CSA381	ETHICAL HACKING	L-T-P-C: 0-0-1-1

Course Description

This course introduces students to a wide range of topics related to ethical hacking and penetration testing. The course provides an in-depth understanding of how to effectively protect computer networks. The topics cover the tools and penetration testing methodologies used by ethical hackers and provide a thorough discussion of what and who an ethical hacker is and how important they are in protecting corporate and government data from cyber-attacks.

Course Objectives

- To understand the core foundations of ethics in regards to computer security.
- Learn about the hacker mindset and the history of hackers
- Understand basic networking and security technologies
- Gain a basic understanding of security policy
- Learn about basic system defense infrastructure

Course Outcomes

Cos	Description
CO1	Describe the importance of ethical hacking.
CO2	Implement several types of system scanners and their functions.
CO3	Demonstrate the function of sniffers on a network.
CO4	Compare various types of attacks and practice the proper defensive recourse for each.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	3	-	-	-	-	-	-	-	1	-	-
CO2	2	2		-	3	-	-	-	-	-	-	1	1	-	-
CO3	3	3			3	-	-	-	-	-	-	2	-	1	-
CO4	3	3	3		3	-	-	-	-	-		-	-	-	-

Syllabus

Unit I

Introduction to Ethical Hacking:- Information Security Overview, Information Security Threats and Attack Vectors, Hacking Concepts, Ethical Hacking Concepts, Information Security Controls, Penetration Testing Concepts, Information Security Laws and Standards

The impact of unethical hacking, Hat categories Ethics and issues of information technology.

Unit II

Reconnaissance, Defining legalities, Social Engineering, Internet foot printing Scanners and Sniffers ,Scanners, Sniffers.

Unit III

TCP/IP Vulnerabilities :- IP Spoofing, Connection hijacking, ICMP attacks, TCP SYN attacks, RIP attacks, IP Security Architecture (IPSec), Encryption and Password Cracking, Cryptography:-Cryptanalysis, Description of popular ciphers, Attacks on passwords, Password crackers.

Unit IV

Types of Attacks:- Spoofing, Session hijacking, Hacking network devices, Trojan Horses, Denial of Service attacks, Buffer overflows, Programming exploits, Types of Vulnerabilities:- Mail vulnerabilities, Web application vulnerabilities,Operating system vulnerabilities, Incident Handling.

Textbooks / References:

1. Jon Erickson, This world-famous hacking book has two editions, one which was published in 2003 and the other in 2008.
2. Alan T. Norman, Computer Hacking Beginners Guide.

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA382	**PYTHON SCRIPTING FOR SECURITY**	**L-T-P-C: 0-0-1-1**

Course Objectives
- In this course students will learn to program in python, using an object-oriented approach. Students will learn and write short and long programs to use python to write programs that automate common security tasks.

Course Outcomes

COs	Description
CO1	Explain the fundamentals of computing with python.
CO2	Solve tasks with OOP python scripts.
CO3	Implement Python OS module functions
CO4	Build networking concepts with Python
CO5	Describe Data processing and Visualization libraries in Python

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PS03
CO1	2	1	3	-	-	-	2	-	-	-	-	-	-	-	2
CO2	2	2	3	-	-	-	2	-	-	-	-	-	-	-	2
CO3	1	3	3	-	-	-	2	-	-	-	-	-	-	1	2
CO4	2	1	3	-	-	-	3	-	-	-	-	1	-	2	2
CO5	-	-	1	-	-	-	-	-	-	-	1	1	1	2	2

Syllabus
Unit I
Fundamentals of Python, REPL, Variables, Datatypes, Control Flow, Functions, Recursion
Containers: List, Tuple, Dictionaries, Sets, Frozensets, Mutable vs Immutable, Generators: list comprehensions, dictionary creation routines.
Unit II
Object-Oriented Programming, Classes and Objects, Data attributes and methods, Serialization and deserialization using JSON, Pickle, Error handling and Debugging, Importing and using modules.
Unit III
Scripting Files and folders, Os.path and pathlib, Process management and command execution, Os.system and subprocess module, Os.exec, os. fork, and os. Kill.
Unit IV
Networking, Socket Module and SSL modules, Socket Creation, Binding, Sending and receiving data, Cryptography, CSPRNG, secrets module, hashlib, fernet, MAC & HMAC.
Unit V
Website Automation, Requests, Scraping, Beautiful Soup, Selenium, Data processing and Visualization with pandas, numpy , seaborn.
Textbooks / References:

1. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education, 2016.
2. https://automatetheboringstuff.com/ (free online version)
3. realpython.com (free articles only)
4. https://jakevdp.github.io/PythonDataScienceHandbook/ (free online version)

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA383	ANDROID PROGRAMMING	L-T-P-C: 0-0-1-1

Course Description

- Android Programming course is gaining importance in today's digital era. Due to the increasing popularity of technology and everything getting digitised, the Android Programming course is winning attention. It helps the aspirants in learning the development of smartphones and other mobile devices. The course helps students learn the development of applications. It expounds the topics like software development, web applications development, app safety and security, app development, app functionality and many more.

Course Objectives

- Through this course students will learn skills for creating and deploying Android applications, with particular emphasis on software engineering topics including software architecture, software process, usability, and deployment..The student will learn the basics of Android platform and get to understand the android application development with Firebase database.

Course Outcomes

COs	Description
CO1	Identifying the Android OS Architecture.
CO2	Interpret the different views, layouts and resource files.
CO3	Applying the different UI components.
CO4	Implementing Android Notifications, Android Preferences API and Services.
CO5	Implementing Application Development with Firebase.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1								1
CO2	2	2	2	-			1								1
CO3	2	3	2	-			2							1	2
CO4	2	3	2					2						1	2
CO5	2	2	3				2						1	2	2

Prerequisite:

- Java Programming
- Windows/Linux OS

Syllabus

Introduction: About Android, Android OS Architecture ,Dalvik Virtual Machine & .apk file extension, Android API levels (versions & version names)

Android Java Basics: Getting started with Android development, project folder structure, simple programming, generating build/APK of the app from Android Studio

First application: Creating Android Project, Android Virtual Device Creation, Set up debugging environment, Workspace set up for development, Launching emulator, debugging on mobile devices.
Basic UI design: Basics about Views, Layouts, Drawable Resources, Input controls, Input Events, Toasts. More UI Components: Layouts - GridView and ListView, Action bar, Adapters, Menus: Option menu, context menu, sub menu, Pickers - Date and Time, Spinners.
Activity and Fragment: Activity, Fragment, Activity Lifecycle and Fragment Lifecycle.

Intents: Implicit Intents, Explicit intents, communicating data among Activities.

Navigation Drawer: Panel that displays the app's main navigation screens on the left edge of the screen Android Notifications – Toast, Dialogs (TimePicker, DatePicker, Progress, Alert), Notification Manager and   Push Notification.

Firebase Application using Android- CRUD operations

As a term project students should implement a mobile app with the following: Understand the app idea and design user interface/wireframes of mobile app. Set up the mobile app development environment.

Textbooks / References:
1. Head first Android Development.
2. Android Programming: Pushing the Limits, Wiley By Erik Hellman
3. Android Application Development Black Book, Dreamtech Press, Pradeep Kothari, KLSI

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA384	**COMPETITIVE PROGRAMMING**	**L-T-P-C: 0-0-1-1**

Course Description
- This course helps the students to apply familiar algorithms to solve complex problems as well as to write efficient code, which is necessary for a programmer.

Course Objectives
- In this course students will learn how to apply algorithms in order to solve complex problems. The goal of this course is to teach students how to apply familiar algorithms to non-intuitive problems. Along the way students will also gain useful skills for which competitive programmers are so highly valued by employers: ability to write efficient, reliable, and compact code, manage your time well when it's limited, apply basic algorithmic ideas to real problems, etc.

Course Outcomes

COs	Description
CO1	Demonstrate knowledge of algorithms and programming languages.
CO2	Describe how to solve real world problems.
CO3	Describe competitive programming.
CO4	Describe approaches applied at the world competitions.
CO5	Implement programming concepts with competitive up solving contest.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	1	-	-	-	-	-	-	-	-	2	-	2
CO4	-	3	1	-	-	-	-	-	-	-	-	-	2	-	1
CO5	1	-	2	-	-	-	-	-	-	-	-	-	1	-	1

Syllabus

Data Structures and Libraries- Sorting, Dynamic arrays, Iterators, Binary Trees, Trie
Problem Solving Paradigms-Divide and Conquer, Greedy, Dynamic Programming
Graphs: Depth First Search, Breadth First Search, Applications of DFS and BFS, Kruskal's, Dijkstra's, Bellman Ford's, Floyd Warshall's, Edmonds Karp's, Special Graphs
Mathematics: Number Theory, Prime numbers, factorial, Combinatorics, Probability Theory, Linear Algebra, String Processing Algorithms
Computational Geometry- Graham's Scan, Intersection Problems.

Textbooks / References:

1. Competitive Programming 3 by Felix Halim and Steven Halim.
2. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests by Antti Laaksonen.
3. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, and Clifford Stein.
4. The Algorithm Design Manual by Steven Skiena.
5. Concrete Mathematics by Donald Knuth, Oren Patashnik, and Ronald Graham, 648 pages.
6. Computational Geometry: Algorithms and Applications by Marc van Kreveld, Mark de Berg, and Otfried Cheong.

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA385	EDGE COMPUTING	L-T-P-C: 0-0-1-1

Course Description

- The course is intended to develop the student's knowledge and abilities of how edge computing and Internet of Things (IoT) can be used as a way to meet application demands in intelligent IoT systems. This includes an understanding and use of the IoT architecture with its entities and protocols, from the IoT devices, via middle layers like edge and fog, up to the cloud. It also includes the understanding of the computing and communication technologies used for IoT, as well as the analysis of their constraints, as e.g. perfor• mance, power efciency, memory size, and communication bandwidth. The course also includes the security and privacy issues related to the area of edge computing, IoT, and big data. Further, it is intended to provide the possibility for the student to, from the basis of relevant literature, reect over and discuss current research and development in regard to highly demanding streaming applications, like advanced sen• sing or machine learning, at the edge of an IoT system. The student should be able under supervision to implement an edge and IoT systems.

Course Objectives

- Build a basic iot system which includes edge computations
- Investigate, discuss, and compare architectural design options regarding the tradeoff between computations and communication in an iot system, depending on application demands and resource constraints
- Identify, read, and understand relevant scientfic publications; review, discuss, and summarize them, and present the findings both orally and in written form.
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Course Outcomes

COs	Description
CO1	Describe basic requirements of edge computing.
CO2	Discuss architectures and applications in fog and edge computing.
CO3	Use fog and edge computing services.
CO4	Demonstrate tools and its usages
CO5	Implement software using standard open-source fog and edge computing software for data analytics.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1									1		
CO2	2	1		1	1										
CO3	1		2	1	1							1	1	1	
CO4	1	1	2	1								1			
CO5	1	2		1		1					2	1	1		

Syllabus

Unit I

IoT and Edge Computing Definition and Use Cases
Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.

Unit II

IoT Architecture and Core IoT Modules-A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.

Unit III

RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.

Unit IV

Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud ProtocolsProtocols,MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions,

MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.

Unit V

Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.

Textbooks / References:

1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806
2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.

References:

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
2. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA386	**R PROGRAMMING**	L-T-P-C: 0-0-1-1

Course Description

The course is intended to develop the student's knowledge and abilities of how R programming can be used for data analysis and visualization. This course is also intended to get the idea of how it can be applied in various machine learning tasks.

Course Objectives

- The main objective is to provide information on R studio environment.
- It focuses on the basic commands and its syntax.
- Focuses on how to do exploratory data analysis using R programming
- Apply R programming on various ML models and its performance evaluation.

Course Outcomes

COs	Description
CO1	Explain the basic syntax of R programming language in RStudio environment.
CO2	Implement the Pre-processing of raw data in R for further analysis.
CO3	Conduct exploratory data analysis and create insightful visualizations to identify patterns.
CO4	Demonstrate machine learning algorithms for supervised and unsupervised learning.
CO5	Evaluate the performance of models and degree of certainty of predictions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	3	-	-	-	3	-	1	-	-	-	-	-	2	-	3
CO3	3	3	3	3	3	-	3	-	-	-	-	-	2	-	3
CO4	3	1	-	2	3	-	2	-	-	-	-	-	2	-	3
CO5	3	3	3	3	1	-	3	-	-	-	-	-	2	-	3

Syllabus

Unit I

Introduction to Data Science Process – Loading Data in R – Exploring Data – Managing Data.

Unit II

Modeling Methods – Choosing and evaluating models – Data Driven Models – Supervised Learning techniques – Unsupervised Learning – Ensemble Models.

Unit III

Delivering Results – Documentation and Deployment – Producing Effective Reports and Visualizations.

Textbooks / References:

1. "R for Data Science", Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. "Data Mining for Business Analytics: Concepts, Techniques and Applications in R", GalitShmueli, et al, Wiley India, 2018.
3. "Practical Data Science with R", Nina Zumel and John Mount, Dreamtech/Manning, 2014

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

| 24CSA387 | **MATLAB PROGRAMMING** | **L-T-P-C: 0-0-1-1** |

Course Objectives

- To impart the knowledge to the students with MATLAB software.
- To introduce students the use of a high-level programming language, Matlab. [scientific problem solving with applications and examples from Engineering]

Course Outcomes

COs	Description
CO1	To impart the knowledge to the students with MATLAB software.
CO2	To provide a working introduction to the MATLAB technical computing environment.
CO3	To introduce students the use of a high-level programming language, MATLAB.
CO4	To introduce different types of toolboxes in MATLAB

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	2	2	1
CO2	2	2	3	-	-	-	-	-	-	-	-	-	1	2	1
CO3	2	3	3	-	-	-	-	-	-	-	-	-	1	2	1
CO4	2	2	3	-	-	-	-	-	-	-	-	-	1	3	1
CAM	2	2	3	-	-	-	-	-	-	-	-	-	1	2	1

Syllabus

Unit 1: Introduction to MATLAB, Installation, basic features, MATLAB Desktop, command window, workspace, current directory, data types

Unit 2: Matrices, control flow and operators, strings, graphics, basic plotting, mathematical functions, programmers' toolbox, array operations and linear equations

Unit 3: M-file scripts, debugging, solving linear systems, polynomials, Eigen values, Eigen vector, interpolation, least square regression, root finding methods.

Unit 4: Statistics and Machine Learning Toolbox-Image Processing Toolbox-Text Analytics Toolbox-Deep Learning Toolbox

Unit 5: GUI Design, Introduction Of Graphical User Interface, GUI Function Property GUI Component Design, GUI Container Writing the code of GUI Callback ,Dialog Box Menu, Designing Applications

Textbooks/References:

1. http://www.eng-tips.com/threadminder.cfm?pid=575
2. http://www.matlabtutorials.com/mathforum/
3. http://www.mathworks.in/matlabcentral/
4. http://www.cfd-online.com/Forums/tags/matlab.html
5. http://diydrones.com/forum/topic/listForTag?tag=Matlab
6. MATLAB Manuals and Handbooks
7. Duane Hanselman, Bruce Little Field ―Mastering MATLAB 7‖ , Pearson Education India

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA388	HIGH PERFORMANCE COMPUTING	L-T-P-C: 0-0-1-1

Course Description

- The course helps to understand methods to improvise the programming aspects for execution on high performance computer systems. It also introduces the fundamentals of graphics processing units and many integrated cores, using their architectures and corresponding programming environments to develop fundamental and advanced parallel algorithms through the GPU. Shared Memory parallel programming and Message Passing Interfaces are also learnt to appreciate the aspects and its purpose.

Course Objectives

- Understand High Performance Computing (HPC) system architectures and various computational models.
- Learn basics of CUDA programming.
- Apply parallel execution models and methodologies for parallel programming and parallel applications development.
- Design and implement compute intensive applications on HPC platform.

Course Outcomes

COs	Description
CO1	Implement high performance versions of standard single threaded algorithms.
CO2	Demonstrate the architectural features in the GPU.
CO3	Design programs to extract maximum performance in a multicore, shared memory execution environment processor.
CO4	Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.
CO5	Describe programming languages Julia or Scala using platforms Apache Spark that support high performance algorithm.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		-	-	-	2	-	-	-	-	-	1	-	-
CO2	2	2		-	1	-	1	-	-	-	-	-	-	-	-
CO3	2	2		2	-	-	-	-	-	1	-	-	-	-	-
CO4	2	2		-	-	-	1	-	-	1	-	-	-	-	-
CO5	2	2	2	-	-	-	1	-	-	-	-	-	-	-	-

Syllabus

Unit 1

Introduction to parallel computing, introduction to OPENMP, OPENMP paradigms, parallel regions, multi-threading, data sharing attribute clauses, worksharing, OPENMP reduction, runtime functions,

Unit 2

OPENMP exercises to illustrate for loop, sections, critical section, synchronization. Divide and conquer strategies using OPENMP.

Unit 3

Introduction to MPI, basics of MPI, MPI function call, example programs on MPI and OPENMP+MPI. Collective communication. Data grouping for communication.

Unit 4

Introduction to Heterogeneous Parallel Computing, GPU architecture, Thread hierarchy,GPU Memory Hierarchy, Vector Addition, Matrix Multiplication algorithms.

Unit 5

Scala REPL, Classes, Immutable and Mutable Fields, Methods, Default and Named Arguments, Objects, Collections overview, Sequences and Sets, Tuples and Maps,Higher Order Functions

Textbooks / References:

1. Wen-Mei W Hwu, David B Kirk, Programming Massively Parallel Processors A Hands-on Approach, Morgann Kaufmann, 3e.
2. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP, MIT Press, 2008.
3. Gropp, Lusk, Skjellum, Using MPI, Using MPI, 2014.
4. https://developer.nvidia.com/udacity-cs344-intro-parallel-programming
5. Existing university courses list: https://developer.nvidia.com/educators/existing-courses
6. Tim Mattson. Introduction to OpenMP. SC11. (Available on Youtube).
7. MPI Video Tutorials by Open-MPI. https://www.open-mpi.org/video/

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

Course Objectives

- To configure virtual networks using network simulator
- To install and exploit security tools for protecting a network
- To implement cryptographic algorithm for building a secure communication network
- To exploit the vulnerabilities in a LAN environment and launch attacks
- To analyze the network packet using Wireshark
- To perform the web penetration testing using Burp suite
- To perform vulnerability assessment of wireless devices
- To exploit vulnerabilities in the systems
- To perform the log analysis using Splunk
- To find vulnerable apps in play store and perform static and dynamic analysis on it

Course Outcome

Cos	Description
CO1	Implementation of various network exploits and its mitigation techniques using simulators and real devices
CO2	To exploit vulnerabilities in LAN, wireless devices and identify the same using penetration testing
CO3	Exploring the reverse engineering techniques for proper classification of Benign and malicious Desktop/ Android applications
CO4	Implementation of Intrusion detection system by applying machine learning algorithms

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2												
C02	2	3	2												
CO3	2	3	2												
CO4	2	2	2												

Syllabus

The experiments make use of Kali Linux distros and other open source security tools.

Experiment No. 1: LAN based Network Security
Set up a simple LAN as shown in Figure 1. M1-3 and S1-3 are machine which have Linux and Windows running.

Figure 1: A Simple LAN environment
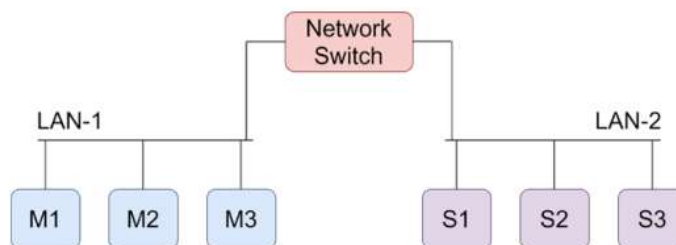
1. Configure LAN-1 and LAN-2 as separate VLANs in the network switch (use inter VLAN ACL).
2. Create a SPAN port in the network switch and send the mirrored traffic to a promiscuous mode port for the purpose of IDS and other packet analysis. Practice port based and VLAN based mirroring.
3. Familiarize with 802.1x, Network Admission Control, Microsoft NAP, RADIUS protocol, RADIUS per port ACL

Experiment No. 2: Network reconnaissance and Protection

1. Installing 'iptable' in Ubuntu VM to allow/block communication between VMs
   a) Installing Email server and Web server in VMs. Usage of Firewall (iptable) in blocking/allowing a sub-network from accessing the servers
   b) Configuring iptable to block Telnet inbound and outbound connections
2. Use 'nmap' tool to perform vertical and horizontal scanning for checking open and closed ports. Use nmap commands for performing the following experiments:
   a) Use ping sweeping to determine which hosts are running.
   b) Check for vulnerable services available using TCP connect scans.
   c) Perform OS Fingerprinting to determine the OS of target machine.
   d) Choose different options under each category according to your creativity.

Experiment No. 3: Application of Cryptographic algorithms using Crypto tools.

Establish a Client-Client Secure communication protocol as shown in Figure 2.
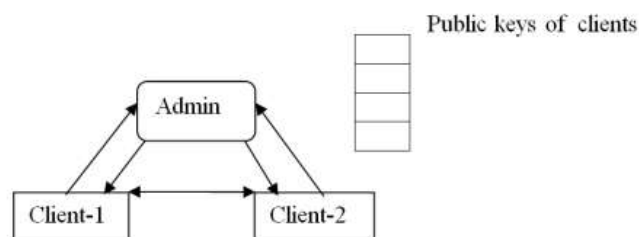

Figure 2: Secure Communication

The Client machines (Client-1 and Client-2) and Admin machine are installed in different VMs. All the three machines are interconnected through a network switch with different IP addresses. The Admin runs a program that generates 2048 bit RSA public and private key for a Client that wants to communicate. Admin generates 2048 bit RSA public and private key for Client-1 and Client-2. The private keys are distributed to client machines and public keys are stored in a structure in the admin machine. When Client-1 wants to send message to Client-2, it encrypts the messages with public key of Client-2. The message is decrypted by Client-2 with its private key. Similar communication pattern from Client-2 to Client-1 need to be maintained.

Manually capture the traffic between the hosts to ensure the proper working of the encryption. Construct an asynchronous communication between Client-1 and Client-2. Run a Wireshark/ TCPdump at the SPAN/Promiscuous port of the network switch and identify the communication between the communicating entities (Admin, Client-1, and Client-2).

Experiment No. 4: LAN based insider attacks

Make use of Ettercap/arpspoof tool to perform ARP cache poisoning based attacks in a LAN environment:
1. Perform Denial of Service (DoS) attacks using ARP Cache poisoning attacks
2. Perform DNS Spoofing attack using ARP Cache poisoning attacks
3. Perform Password stealing (over plaintext) using ARP Cache poisoning attacks
4. Invoke 'sslstrip tool' for stealing password from any machine that is connected in a LAN by stripping the https connection.

For all the above attacks, observe the ARP cache table, CAM table, etc., before and after the attack. Run Wireshark and observe the traffic patterns before and after the attack.

Experiment No. 5: Network Packet analysis using Wireshark.

Use Wireshark to solve the below scenarios:

1. You, as a SOC analyst noted that someone try to send information (PING) to unknown IP address and you are suspecting some malicious information might transferred in it. Analyse the log file and find the data.
   a) Find the source and destination IP of that log.
   b) Find the Data length (Bytes) and verify the checksum status on destination.
2. Now you have found that some kind of file is been downloaded by insider in unencrypted web traffic. Your task is to
   a) Find the type of file.
   b) Export that file from that web traffic, then analyse the file for any secret information.
   c) Find the hostname in which the file is stored.
3. Based upon their activities, auditing team has started investigation against them and found that the insider passed some sensitive information via call to someone. The traffic is been captured. Analyse the traffic and find those conversations and extract the sensitive information in it.
   a) Find the call-ID when the status of the call is ringing.
4. On further investigation, you have a suspect on some wireless device communications. List out the Bluetooth devices communications from this traffic and find the details about native Bluetooth adapter.
5. Analyse the captured WPA handshake from this traffic and report in detail about it to your administrator.
   a) Geo locate all the endpoint of wireless devices.
   b) Analyse the protocol level information transfer between wireless devices.

Experiment No. 6: Web Penetration testing using Burp Suite.
1. Configure burp suite in machine A and access the request and response going throw machine B. Both A and B machines should be pingable.
2. Intercept an https request through butpsuite using import/export CA certificates.
3. Intercept a web application login credentials using burpsuite and resend request using repeater.
4. Use intruder to bruteforce password list.

Experiment No. 7: Wireless Security Lab
Perform a VA/PT on your local Wi-Fi network and try automated attacks with NetStumbler and Kismat to gather information wireless network and try attacks like CowPatty and Airsnort. Further execute aircrack-ng to simulate attacks 802.11 WEP and WPA-PSK keys for auditing wireless networks and performing airodump, aircrack, airmon, airbase, aireplay and airtun using Kali 2.0 (Sana) Linux. Attempt a Wi-Fi sniffing to gather location data which can be used to identify device parameters of wireless communication devices.

Experiment No. 8: Exploiting the vulnerabilities on a system

Use Metasploit (open-source exploit framework) to write and test your own exploit into any PC/Site with existing payloads using Virtual Machines in Ubuntu Host and Windows XP Virtual disk. These traces should be executed in OllyDbg step by step, and debug the protocols every single command, laidback with registers and flags, with buffer information. Also debug standalone DLL's like Message Box and wsprintf. Use IDA Pro (evaluate a limited version of the disassembler) to examine a protected and obfuscated sample executable. (.NET Reflector can be used to search through, the class hierarchies of .NET assemblies, even without any source code). Perform static and dynamic code auditing.

Experiment No. 9 : Log analysis using Splunk

Understand the architecture of Splunk and installation process. Familiarize with the dashboard fields. Run any process in forwarder and use corresponding query to capture that log in Splunk. Run any malware of malicious process in forwarder, capture the log and analyze the malware using Splunk.

Experiment No. 10: Mobile & Smart phone security Lab
Familiarize with android application .apk files. By performing static and dynamic analysis on the app. Find the vulnerable application and document the inferences

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA481	ALGORITHMS LAB	L-T-P-C: 0-0-1-1

Objectives:
- The **course** is designed to develop skills to design and analyse algorithms
- Apply logical thinking to build innovative solutions for real-life problems.

Course Outcomes

CO1	Learn to Implement different sorting algorithms
CO2	Understand BFS and DFS and its implementation
CO3	Create and test optimal solutions using various algorithms for real-life problem.
CO4	Learn programming techniques like Divide and conquer
CO5	Understand Dynamic Programming based solutions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	2	-	-	-	-	-	-	-	1	-	2
CO2	3	3	-	2	1	-	-	-	-	-	-	-	1	-	2
CO3	3	3	-	2	1	-	-	-	-	-	-	-	1	-	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	2	-	2
CO5	3	3	3	2	-										

Syllabus

Implementation of sorting algorithms – Bubble sort, Insertion Sort, Selection Sort, QuickSort- Merge Sort, Heap implementation using array, Heap sort, performance comparison of sorting algorithms for various classes of inputs like nearly sorted, unsorted etc.$O(V2)$ and $O(E \log V)$ implementations of Dijkstra algorithm, BFS and DFS implementation,graph cycle detection using BFS. Topological sort using DFS, Prims and Kruskals MST. Divide and conquer implementation of Maximum subarray sum Dynamic Programming based solution for 0-1 Knapsack problem, Recursive matrix chainMultiplication, Longest common substring,

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

| 24CSA482 | **XAMARIN NATIVE APPLICATION DEVELOPMENT** | **L-T-P-C: 0-0-1-1** |

Course Objectives

- Students will begin by learning how to use Xamarin.Forms to build Android and iOS apps using a single code base. Students will learn how to use XAML to define the UI layer for all platforms. By installing the app on both Android and iOS simulators and real test devices, they will see how the UI renders as native controls on each platform, thereby giving the app a native look and feel.

Course Outcomes

COs	Description
CO1	Understand the Anatomy of a Xamarin.
CO2	Demonstrate the Customizing XAML.Forms controls on the Android and iOS.
CO3	Explain the skill to Making calls, and processing data from, RESTful services
CO4	Demonstrate the Configuring a Xamarin development system.
CO5	Understand the NuGet and the Xamarin Stor.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	3	2	3			1	2			2			3
CO2	2			2	3	1		1		2	3	2			2
CO3		1	3	2	3		3			1		1			
CO4	3			2	3	1			2		2	3		2	
CO5	1	1	3	2	3		1			1		2		2	1

Syllabus

UNIT I

Introduction to Visual Studio :- Environment Overview, Solutions and Projects,Debugging Techniques, Intellisense, Introduction to NuGET and GitHub.

UNIT II

Xamarin Forms Overview :- XAML (Extensive Application Markup Language) Basics,XAML Layout and Design, StackLayout, Views (Controls), Listviews, Context Actions, Cell Design,

UNIT III

C# Code-Behind:- C# Essentials, Variable types, List<>, If/Then, Loops, Constructors, Introduction to OOP (Object Oriented Programming), Encapsulation, Inheritance, Class, Object

UNIT IV

MVVM (Model-View-ViewModel) :- Data Binding, Navigation, Multi Page Application, Data Persistence, Local Database Design, Designing for iOS and Android, iOS, Visual Studio for Mac, Visual Studio for Windows with Xamarin Mac Build Agent,

UNIT V

Android Deployment :-Android Emulator, HyperV and Virtualization, Android phone in Developer, Mode, App Publishing, App Stores, App Store, Google Play Store, MDM (Mobile Device Management)

At the end of the course participants will be able to

1. Build native mobile apps for Android, iOS and Windows using C#
2. Understand the fundamentals of Xamarin Forms and its architecture
3. Build user-interfaces with XAML and code
4. Work with images
5. Present data in beautiful, interactive lists
6. Implement multi-page apps with navigation, tabs, master/detail pages
7. Build forms and setting pages
8. Store and retrieve data from a variety of sources (file system, SQLite database and RESTful services)
9. Implement Model-View-ViewModel (MVVM) architectural pattern

Textbooks / References:

1. Xamarin Mobile Application Development: Cross-Platform C# and Xamarin.Form s Fundamentals

Paperback.

2. Xamarin Mobile Application Development for iOS: If you want to develop iOS apps with Xamarin, and this comprehensive tutorial has it all. Covering everything from the UI to using TestFlight, it's your fast route to the App Store.

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA483	ASP.NET CORE RESTFUL WEB SERVICE DEVELOPMENT L-T-P-C: 0-0-1-1

Course Objectives

- All .NET Beginner(s)/Professional(s) who are keen to develop modern, light weight and cloud based web applications should go for this course.ASP.NET Web form and ASP.NET MVC available because of its age is considered to be very matured for web application development, it is because of the popularity of ASP.NET Core Framework and many exclusivefeaturesofASP.NETCorethat todayit isdominating over Web Formsand MVCare first choice for large sized enterprise web application development

Course Outcomes

COs	Description
CO1	Understand the benefits of MVCdesign over traditional ASP.NET WebForms.
CO2	Demonstrate the Develop Service Oriented RESTful services using WebAPI feature of ASP.NETCore.
CO3	Explain the Modularize using Areas.
CO4	Understanding and applying validation framework for both client and server validations.
CO5	Demonstrate the deploy ASP.NETCore application to the production server.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	3	2	2			1	2			2			3
CO2	2			2	2	1		1		2	3	2			3
CO3		1	3	2	2		3			3		1			
CO4	3			2	2	1		2	2		2	3		2	
CO5	1	1	3	2	1		1			3		2		2	1

Syllabus

UNIT I

Introduction to ASP.NETCoreFeatures:- Understanding ASP.NETCore MVC, MVCPattern, Advantages of ASP.NETCore, ASP.NETCore vs. ASP.NET MVC vs. ASP.NET Web Forms. ASP.NETCore Environment Setup, ASP.NETCore First Application,Project Layout,Understanding Life Cycle of ASP.NetCore Request.

UNIT II

Controllers & ActionMethods:- Controllers Overview,Action Methods and IAction Result object,Passing data from Controller to View,Understanding Action Selectors, ActionFilters,BuildingCustomActionFilters,Middleware,Asynchronous Action Methods. Introducing Razor View,Advantages of RazorView,Razor Syntax,Types of Views,Partial Views.

UNIT III

Validations & DataAnnotations:- Data Annotations and Validations Overview,Validations with Data Annotation,Server Side and Client Side Validation,Custom Server side validation,Model level validation using IValidatable Object,Customun obstrive Client side Validation,Remote Validation.

UNIT IV

ASP.NETCore - WebCaching:- CacheTag Helpers,Memory Caching Introduction,In-Memory Caching,Response Cache,Distributed Cache, Url Routing Overview,Custom Routes,Attribute Routing,Routing Constraints.

UNIT V

Bundling & Minification:- Bundling and Minification in ASP.netCore,Bundler and Minifier Extension,How to Bundle your files,How to minify your Bundles,Convert to Gulp. Product Abstract Document,Requirement Specification Document

Textbooks / References:

1. Form s Fundamentals Paperback. Hands-On RESTful Web Services with ASP.NET Core Paperback – Import, 27 December 2019
2. Building RESTful Web Services with .NET Core By Gaurav Aroraa , Tadit Dash

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA484	FLUTTER APPLICATION DEVELOPMENT L-T-P-C: 0-0-1-1

Course Objectives

Students has to learn how to use Flutter to develop high-quality, interactive mobile applications both for iOS and Android devices. In this training course, you will learn how to how to code using Dart and build beautiful, fast, native-quality iOS and Android apps.

Course Outcomes

COs	Description
CO1	Understand the features and installation of Flutter.
CO2	Demonstrate the basic programming constructs of Dart.
CO3	Explain the simple mobile applications in Flutter using Dart language.
CO4	Understanding and applying mobile applications using database Connections.
CO5	Demonstrate Build Animation on Flutter.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	3	1	2			1	2			2			3
CO2	2			3	2	1		1		2	3	2			3
CO3		1	3	3	3		3		1	3		1			
CO4	3			3	2	1		2	2		2	3		2	
CO5	1	1	3	3	1		1		1	3		2		2	1

Syllabus

UNIT I Introduction to Flutter:- Features of Flutter- Advantages of Flutter- Disadvantages of Flutter. Flutter Installation- Installation in Windows- Installation in Mac OS- Creating Simple Application in Android Studio - Architecture of Flutter Applications

UNIT II

Flutter Basics:- Widgets- Gestures- Concept of State- Layers- Introduction to Dart Programming-Variables and Data types- Decision Making and Loops. Functions- Object Oriented Programming. Introduction to Widgets- Widget Build Visualization

UNIT III

Introduction to Layouts:- Type of Layout Widgets- Single Child Widgets- Multiple Child Widgets- Advanced Layout Application-Introduction to Gestures- Statement Management in Flutter. Ephemeral State Management-Application State - scoped model- Navigation and Routing.

UNIT IV

Animation on Flutter :- Introduction to Animation Based Classes-Work flow of the Flutter Animation- Working Application- Android Specific Code on Flutter- Introduction to Package- Types of Packages- Using a Dart Package- Develop a Flutter Plugin Package- Accessing Rest API- Basic Concepts- Accessing Product service API

UNIT V

Database Concepts:- SQLite- Cloud Fire store- Internalization on Flutter- Using intl Package-Testing on Flutter- Types of Testing- Widget Testing- Steps Involved- Working Example-Deployment- Android Application- IOS Application- Development Tools- Widget Sets- Flutter Development with Visual Studio Code- Dart DevTools- Flutter SDK

Textbooks / References:

1. Beginning App Development with Flutter by Rap Payne
2. Beginning Flutter Paperback – Illustrated, 15 November 2019by Marco L. Napoli (Author)

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

24CSA485	SMART PROGRAMMING	L-T-P-C: 0-0-1-1

Course Objectives

- Students will be able to write efficient, effective, and secure smart contracts in an object-oriented way by using Solidity language and Remix IDE and interact with Ethereum Smart Contract

Course Outcome

COs	Description
CO1	Understand smart contracts
CO2	Implement smart contracts using Remix IDE and Solidity
CO3	Understand error handling in Solidity
CO4	Implement assembly code in Solidity
CO5	Learn interacting with Ethereum Smart Contract Using Web3js

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	-	-	-	-	-	1	-	2
CO2	3	2	2	2	1	-	-	-	-	-	-	-	1	-	2
CO3	3	2	2	2	1	-	-	-	-	-	-	-	1	-	2
CO4	3	2	2	1	1	-	-	-	-	-	-	-	2	-	2
CO5	3	2	2	1	1										

Syllabus

Smart Contract in Solidity- Execute Solidity Smart Contract using Remix IDE- Hashing in Solidity- Solidity – Error Handling- Hashing in Solidity- Creating Ownable Contracts in Solidity- Solidity – Abstract Contract- Solidity – Basics of Interface- Solidity – Basics of Contracts- Solidity – Functions- Solidity –Constructors-Solidity-Inheritance - Solidity – Error Handling-Build a Authentication Using Blockchain- Solidity – Mappings- Solidity – Assembly- use GANACHE Truffle Suite to Deploy a Smart Contract in Solidity (Blockchain)-- Solidity – Special Variables- Interacting With Ethereum Smart Contract Using Web3js- Solidity – Libraries

Textbooks / References:
1) Smart Contracts: Author: Patrick Ejeke Amazon Asia-Pacific Holdings Private Limited
    2) Solidity Programming Essentials: A guide to building smart contracts and tokens using the widely used Solidity language Publisher: Packt Publishing- Ritesh Modi

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

22AVP201   Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

22ADM211 Leadership from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

22ADM201 Strategic Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

22AVP204 Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

22AVP205   Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

22AVP206 Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

22AVP207 Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

22AVP208   Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

22AVP209 Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP210 Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

22AVP213 Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in

Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

22AVP214 Principles of Worship in India

Indian mode of worship is unique among the world civilizations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realization of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

22AVP215   Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

22AVP218 Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

22AVP219 Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

22AVP220 Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

22AVP221 Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Course Objective: The course will enable the students to understand the basics of grammar and usage, to appreciate the literary compositions, and to understand the intricacies of language and literature.

Course Outcomes: By the end of the course the students will be able to:
1. Distinguish various literary genres.
2. Explore tradition and culture through literature.
3. Apply   the basics of grammar.
4. Critically analyse the prescribed   literary texts.

UNIT 1
Hindi Sahithya ki Panch shresht Kahaniyam**:**
a.Sughmay Jeevan –Chandradhar Sharma ,Guleri
b.Dhan ki Bhent-Rabindranath Tagore
c.Anbola –Jayashankar Prasad
d.Swamini (Manasrovar bhagh-1) Premchand

UNIT 2.
Hindi Kavitha:
a.'Aarya" –Maithili Sharan Gupth
b. "Meribhi abha he Ismein' .,"Mubarak Ho Naya Saal"-_Nagarjun
c. "Nishaa Ki rod eta Rakesh- Nihar se'.,Shoonya Mandir meinBanoongi-Sandhya Geet se - Mahadevi varma
d.'KhoobLadi Mardani vahtho Jhansi Vali rani thi'-subhadra Kumari chohan

UNIT 3.
Hindi Ekanki**:**
a) Mohan Rakesh :Andeke Chilke
b) Vishnu Prabhakar :Sarkari Noukari

UNIT 4.
Grammar:1)Karak2) Upasarg3)Pratyay4)Vakya Rachana 5)Padaparichay.6)Sarvanam7)kriya 8)Adjective 9)Adverb10)Tenses

REFERENCE
1. Sugam Hindi Vyakarn, :Prof.Vanshidhar & Dharmapal Shastri
2. Vyavaharik Hindi Vyakarantatha Rachana: Dr.Hardev Bahari
Shiksharthi HindiVyakaran:Dr. Nagappa
3. Hindi Sahithya ki Panch shresht Kahaniyam**:** Edited by: Dr.Sachidanandh Shuklu
(Printed and Published by V&S publishers, Abridged, AnsariGanj, Delhi)
4. Hindi Samay.com,/Hindikahani.com/exotic indiaart.com

24MAL101   **Malayalam I**   **LTPC: 2 0 0 2**

Course Objectives:
- To enable the students to acquire basic skills in functional language.
- To develop independent reading skills and reading for appreciating literary works.
- Enable students to communicate in the language they have studied in a range of contexts and for a variety of purposes
- To analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech

Course outcomes:
CO1: Develop the ability to read and critically appreciate a given text
CO2: Develop fluency in speaking the language
CO3: Ability to blend language and Indian spirituality.

Unit	Topic
1	**Adhyatmaramayanam,** Tharopadesam(Enthinnu Sokam….thulom) -------------------------------------- **Jnanappana** (sthanamanangal….Trishnakondubhramikkunnathokkeyum)
2	Modern Poets: Mampazham-Vyloppilly Sreedharamenon Critical analysis of the poem.
3	Short stories from period 1/2/3:**Poovanpazham**-Vaikaom Muhammed Basheer
4	Literary Criticism: **Bharatha Paryatanam-***Vyasante Chiri*–Ithihasa studies-Kuttikrishna Marar-Outline of literary Criticism in Malayalam Literature
5	Error-freeMalayalam: **1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam – Writing-**a**. Expansion of ideas; **b**.PrecisWriting; **c**. Essay Writing

Text books/Reference :
1. Adhyatmaramayanam – Thunjath Ramanujan Ezhuthachan
2. Ramayanavichinthanam-Dr. A. M. Unnikrishnan
3. Thunjan Padhanangal-Prof.Panmana Ramachandran
4. Compleate Works including Jnanappana-Poonthanam
5. Vyloppilly-M.N.Vijayan
6. Vyloppilli-Vyakthi,Kavi-Dr.M.Leelavathi/S.Gupthan Nair
7. Basheerinte Poonkavanam-Prof.M.N.Karasseri
8. Basheer-Life & Works
9. Bharatha Paryatanam-Kuttikrishna Marar
10. Lavanyasastrathinte Yukthisilpam-Dr.Thomas Mathew

  11)Thettillatha Malayalam – Prof.Panmana Ramachandran Nair(His all books on Error Free Malayalam)

24KAN101   **Kannada I**   **LTPC: 2 0 0 2**

Objectives:
- To enable the students to acquire basic skills in functional language.
- To develop independent reading skills and reading for appreciating literary works.
- Enable students to communicate in the language they have studied in a range of contexts and for a variety of purposes
- To analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech

Course Outcome

CO1	Develop the ability to read, listen and write in Kannada and to understand and use the language in a variety of contexts and situations
CO2	To enable the learners to understand the grammatical structures of classes of words
CO3	Develop ability to speak fluently and interactively in both personal and professional context

Course Contents

UNIT – 1

    Adalithadalli Kannadada balake: (Use of Kannada in business and administration)
    Bhashe – swaroopa, stityantaragalu,
    Aadu bhashe, pradeshika bhashe, Grantika bhashe
    Paaribhaashika padagalu

UNIT – 2

    Padagala rachane,deshiya – anya deshiya padagalu
    Lekhana Chinnhegalu
    Kannada bharavanigeya shuddha mattu ashuddha roopagalu,
    Dwiruktigalu, jodunudigalu

UNIT – 3

    Nudigattgalu, gaade vistarane
    Listening to radio speech, tongue twister - practice

UNIT – 4

    Patra Lekahna - aupachaarika haagu anoupachaarika
    Kandikegala rachane
    Prabandhagalu: vivaranaatmaka haagu niroopanatmaka

UNIT – 5

  Poems
- Vachanagalu – kaalugalembavu gaali kandaya – Allamaprabhu,Ratnada sankoleyaadade todarallve – Akkamahadevi, ole hatti uridare nilabahudallade - Basavanna
- Keerthanegalu – Tanuva nirolagaddi phalavenu – Purandaradasa, Tallanisadiru kandya taalu manave - Kanakadaasa
- Tripadigalu – Saalavanu kombaaga haalogarundante - Sarvagna
- Janapada geetegalu - Yaake badtaadti tamma

 Short stories
- Sambhanda – Shrikrishna Alanahalli
- Moksha – Sethuram
    Prabandhagalu
- Namma Maneya Deepa – Ha.Ma.Nayak
- Bhadhuku Kanasalla, Ondhu Kale – N K Kulakarni

References:

1. H.S.Krishnaswamy Iyangaar – Adalitha Kannada – Chetana publication, Mysuru
2. Kannada Vyakarana mattu Rachane – N.Gopalakrishna Udupa, M.C.C.Publication
3. G.H.Naayak – Kannada Sanna Kathegalu – Chetana Book House
4. Shatamaanada Lalitha Prabandha – Gurulinga Kaapase - Karnataka Sahitya Academy
5. Naavalla – Kathasankalana – Sethuram
6. Basavannanavara Vachanagalu – G.V.Shastri – Paaru prakashana
7. Kannadada Balake – H.S.Krishnaswamy Iyangaar – Chetana book house
8. Sarvagnana Vachanagalu – Venkata Subbaiha, Vijayavaahini Publications

24SAN101   **SANSKRIT I**   **2 0 0 2**

Course Objectives:

- To enable the students to acquire basic skills in functional language
- To develop independent reading skills and reading for appreciating literary works.
- To analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech
- Grasp the connection between Sanskrit language and Indian philosophy

Course Outcomes:

CO 1 Read and understand Sanskrit verses and sentences and communicate in Sanskrit

CO 2 Imbibe values of life and Indian tradition propounded by the scriptures

Module I

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Module II

Verbs- Singular, Dual and plural — First person, Second person, Third person.

Tenses – Past, Present and future – Atmanepadi and parasmaipadi-karthariprayoga.

Module III

General group words for communication and moral stories.

Module IV

ChanakyaNeeti chapter III (part I), Bhagavad Gita chapter 14 (part I)

Module V

Translation of simple sentences from Sanskrit to English and vice versa.

Course Objectives:

To teach Tamil for effective communication in different spheres of life: - cultural relations in society.

Course Outcomes:

1. Giving exposure to history of Tamil literature and Introduction of select Classics
2. Initiating Students to the spirit of Bhakti literature
3. Encouraging creativity of students by teaching Contemporary Literature poetry, modern poetry, Short Story, Prose, Novel, etc
4. Introduction of basic Grammar, Letter writing and essay writing skills of Tamil language.

அலகு-1

தமிழ்இலக்கியவரலாற்றில்சங்கஇலக்கியம்: முதல், இடை, கடைசங்கம்.

சங்கஇலக்கியங்கள்பத்துப்பாட்டு.

குறுந்தொகை (6,8பாடல்கள்),

புறநானூறு (184,192பாடல்கள்).

சங்கம்மருவியகாலஇலக்கியம்:

சிலப்பதிகாரம் (வழக்குறைக்காதை),

பதிணென்கீழ்கணக்குநூல்கள்,

திருக்குறள் (மருந்து)

UNIT-1 History of Tamil Literature: First, Intermediate, Last sangam. Sangam Literature, Pattuppaattu. Kuṟuntogai, Puṟanaanuuru.

Literature of the Sangam Maruviya period – Silappathiagaram (vazhakkuraikaathai), PatiṇeṇkiizhKaṇakkuNuulkal. TirukkuṟaL (Marunthu)

அலகு 2

பக்திஇலக்கியம்:–

பன்னிருதிருமுறைகள்அறிமுகம்,

மாணிக்கவாசகர் (திருவாசகம்- சிவபுராணம்)

UNIT 2 Bhakti Literature – Introduction to PanniruThirumuraikal, Manikkavasagar (Thiruvasagam- Siva Puranam)

அலகு -3

தற்காலஇலக்கியம்:-

கவிதை : பாதியார் (குயில்பாட்டு), பாரதிதாசன் (தமிழின்இனிமை).

உரைநடை:   ஞா.தேவநேயப்பாவாணர் (தமிழும்திரவிடமும்சமமா?),

பரிதிமாற்கலைஞர் (தமிழ்மொழியின்வரலாறு (ஆதிவரலாறு)).

சிற்பி (வள்ளுவர்வகுக்கும்இன்பம்)

சிறுகதை:   அழகியபெரியவன் – (வனம்மாள்)

நாவல்:   இமையம் (பெத்தவன்)

UNIT-3 Contemporary Literature: Poetry - Bharathiar(kuyilpāṭṭu), Bharathidasan (tamiḻiṉiṉimai, iṉpattamiḻ) Pattukottai Kalyanasundaram.

Prose: G. DevaneyaBhavanar (TamizhumDhiravidamumsamamaa?), Paritimāṟkalaiñar (paranarkettaparisu), chirbi (valluvarvakukkuminbam)

Short Story: Azhagiya Periyavan – (VanammaaL)

Novel: Imaiyam (Peththavan)

அலகு – 4தொல்காப்பியம்:

எழுத்து – பிறப்பியல்.

நிறுத்தக்குறிகள்மற்றும்

கடிதம்எழுதுதலும்கட்டுரைஎழுதுதலும்

UNIT – 4tolkāppiyam: Alphabet – piṟappiyal. Punctuation marks and Letter writing and essay writing.

REFERENCE

இமையம், *பெத்தவன்*, க்ரியாவெளியீடு 2019.

அழகியபெரியவன் ,*அழகியபெரியவன்கதைகள்*, நற்றிணைபதிப்பகம், 2016

சி.பாலசுப்பிரமணியன், *கட்டுரை-வளம்*, நறுமலர்ப்பதிப்பகம், பத்தாம்பதிப்பு 1994

பரிதிமாற்கலைஞர் ,*தமிழ்மொழியின்வரலாறு*, பூம்புகார்பதிப்பகம், ஆறாம்பதிப்பு 2013.

அகளங்கன், *பன்னிருதிருமுறை – அறிமுகம்*, இந்துமாமன்றம்வவுனியா, 1994

ரா. சீனிவாசன ,*தமிழ்இலக்கியவரலாறு* ,https://ta.wikisource.org/s/99uk

மாணிக்கவாசகர் (திருவாசகம்- சிவபுராணம்

பொன்மணிமாறன் "அடோன்தமிழ்இலக்கணம் "அடோன்பப்ளிஷிங்குரூப், வஞ்சியூர், திருவனந்தபுரம், 2007.

http:/www.tamilvu.org/libirary/libindex.htm.

http:/www.gunathamizh.com/2013/07/blog0post_24.html

Objectives:
- To expose students to various genres of English literature
- To expose the students to Indian English Writing of different timelines.
- To develop a sensibility to read and understand literary works.
- To introduce a few linguistic devices to enable them to appreciate literary forms stylistically

COs	Course Outcomes
CO 1	Identify and distinguish various genres of English Literature for better understanding
CO 2	Demonstrate an ability to comprehend and analyse literature independently
CO 3	Develop or enhance the ability to appreciate and use linguistic devices for stylistic analysis

Unit-I
Introduction to Literature – Nature & Elements of Literature, literature as an expression of personal & historic aspects. Narrative structure & technique. Introduction to Indian Literature: Pre-independence, postindependence, themes, writers, and problems.

Unit-II
Linguistic Devices: Theme, Diction, syntax & syntactical deviations, Rhetorical devices, figures of speech

Unit-III
Poetry:
The Frog and the Nightingale by Vikram Seth
An Indian Love Song by Sarojini Naidu
Death of the Wolf by Toru Dutt

Unit IV
Short stories:
Detail-
 A Dog's Life by Mulk Raj Anand
 Interpreter of Maladies by Jumpha Lahiri

Unit-V
 Non-Detail Reading:
Three Persons by Vijay Sheshadri
The Wolf's Postcript To 'Little Red Riding Hood' **by Agha Shahid Ali**
The Naive Friends by Premchand
The Woman on Platform 8 by Ruskin Bond

Core Reading :
- Iyengar, Srinivasa **– *The Indian Contribution to English Literature*.** Karnatak ishing House, Bombay, 1945
- Iyengar, Srinivasa – ***Indian Writing in English : 1800-1980*** – Sterling Publishing House, 2019

References
- Seth, Vikram, ***Beastly Tales,*** Penguin India, 2013
- Naidu, Sarojini, ***The Golden Threshold*** 1905
- Dutt, Toru - ***A Sheaf Gleaned in French Fields*** 1876
- Anand, Raj Mulk, ***Selected Short Stories*** Penguin India, 2006
- Tagore, Rabindranath, ***Mashi and Other Stories,*** True Sign Publishing House, 2021
- Lahiri, Jumpha - ***Interpreter of Maladies*** Harpercollins Publishers India, 2005
- Sheshadri, Vijay – POETRY Magazine, December 2010
- Ali, Shahid Agha, ***The Wolf's Postcript To 'Little Red Riding Hood'*** Academy of American Poets, poets.org
- ***Premchand - , Mindfuel's 4 In 1 Story By Munshi Premchand - Power Of A Curse, The Naive Friends, A Complex Problem & A Lesson In The Holy Life* Mindfuel Publishers*, 2020***
- *Bond, Ruskin - **The Woman on Platform 8,** **The Illustrated Weekly of India***

Evaluation Pattern :

Assessment Component	Weightage
Continuous Evaluation (Class Tests, Assignment, Class Activity)	20
Mid Term Examination	30
End Semester Examination	50
Total	**100**

24MAL111   **Malayalam II**   **LTPC: 2 0 0 2**

Course objective:

- To develop independent reading skills and reading for appreciating literary works.
- To develop elaboration and modernization of the vocabulary of a language
- To enable the students to plan, draft, edit & present a piece of writing.

Course outcomes:
CO1: Develop the ability to read and critically appreciate a given text
CO2: Develop fluency in communication
CO3: Develop interest in blending of language and Indian Spirituality
CO4: To enable the learners to understand the grammatical structures of classes of words

Unit	Topic
1	Memoirs-One of the Selecrtion from Chiudambara Smarana-Balachandran Chullikkadu-Critical analysis of his poetry)
2	Ancient Drama: ***Kerala Sakunthalam*** (Act 4), Kalidasan (Transilated by Attoor Krishna Pisharody).
3	Satire One of the Selection from Chemmanam Chacko,VKN Or Punathil Kunjabdulla- philosophical dimens of Satire
4	Part of an auto-biography/travelogue: **Valarnnu varunna oratmavu(from Kanneerum Kinavum)-VT Bhattathirippad**
5	Error-freeMalayalam: **1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam – Writing-**a**. Expansion of ideas

Text books/Reference:
1) Hasa Sahithyam Kuttikrishna Mararu
2) Sakunthalam-Attoor/Kuttikrishna Marar
3) Kalidasa Hridayam-K.P.Narayana Pisharady
4) VKN-K.P.Appan
5) N.V.Krishna Warriar & Modern Poetry studies
6) Kanneerum Kinavum –V.T. Bhattathirippad
7) Adukkalayil Ninnu Arangatheykku-V.T.Bhattathirippadu
8) Nalla Malayalam- C.V.Vasudeva Bhattathiri
9) Tettum Sariyum-Prof. Panmana Ramachandran Nair

24HIN111	**HINDI II**	**2 0 0 2**

Course Objective: The course will allow students to apply grammar in language structures, appreciate the literary compositions and provide them with a good command over translation techniques.

Course outcomes: By the end of the course the students will be able to:

1. Understand the postmodern trends of literature...
2. 2.Explore tradition and culture through literature.
3. Apply ethical and professional translation strategies.
4. Demonstrate linguistic competence in written communication.

UNIT 1

Hindi Laghu Upanyas **:Mamatha Kaliya- ' Doud'**

UNIT 2

Hindi Natak**:** Swadesh Deepak- "Kort Marshal"

UNIT 3.

Adhunik Hindi Kavya a.Jayashankar Prasad-(Lahar, Aah!Vedhana Mili Vidayi)., b.Suryakanth Tripathi „Nirala"- (Anamika -4)., c.Subadhra Kumari , Chouhan- (Swadesh Ke Prathi, Smruthiyam), d.Gajanan Madhav Muktibodh- (ek swapna Katha)

UNIT 4.

A)Sankshepan,

B) .Anuvad: Paribhasha,Prakar,AnuvadKeLakshan,AnuvadKiAvashyakata,Passage (Translation)

c)Paragraph writing

D)Technical writing

REFERENCE

1. Prayojan Mulak Hindi Ke Naye Ayam   : Dr. Pandit Banne
2. Prayojan Mulak Hindi Ki Nayi Bhumika   : Kailash Nath Pandey
3. Prayojan Mulak Hindi Ke Vividh Roop   : Dr. Rajendra Mishra, Rakesh Sharma
4. "Adhunik Kavya Sangraha"   Edited by . Dr. Urvashi Sharma (Printed and Published by Malik & Company, Jaipur)
5. Hindi Samay.com,/Hindikahani.com/exotic indiaart.com

Objectives:
- To develop the standard of orthography and spelling system.
- To develop independent reading skills and reading for appreciating literary works.
- To develop elaboration and modernization of the vocabulary of a language.
- To enable the students to plan, draft, edit & present a piece of writing.

Course Outcome

CO1	Develop the ability to read and critically appreciate a given text
CO2	Develop pattern of communication as required for different professional context
CO3	Develop fluency in speaking the language

Course Contents

UNIT – 1
Prabandhagalu

- Thotadacheya Bhoota – Kuvempu
- Bantu Bannada Holi – G. S. Shivarudrappa

UNIT – 2
Poems
- Ni hinga nodabayda Nanna – Da. Ra. Bendre
- Huttarihaadu – Panje Mangesh Rao
- Tungabadre – K.S.Narasimhaswamy
- Nanna Janagalu – Dr.Siddhalingaya

UNIT – 3
Novel
- Jugari Cross – Poornachandra Tejaswi

UNIT – 4
- Suttole
- Kadata
- prakatane
- Arjigalu
- Aadesha patraa

UNIT- 5
- Varadigalu
- Sanshikpta Baravanige
- Prabandhagalu: vaadaatmaka haagu vishleshanatmaka

References:
1. Jugari Cross – Poornachandra Tejaswi – Pustaka Prakashana
2. Shatamaanada Lalitha Prabandha – Gurulinga Kaapase - Karnataka Sahitya Academy
3. N.Gopalkrishna Adiga – Kannada Vyakarana mattu Rachane – MCC Publications
4. Maadhari Patragalu – S.R.Siddharaju – Kannada Saahitya Parishattu
5. H.S.Krishnaswamy Iyangar – Adalitha Kannada – Chetana publication, Mysuru

SANSKRIT II

Module I

Seven cases, Avyayas, sentence making with Avyayas, Sapthakakaras.

Module II

Kthavathu Prathyaya, Upasargas, Kthvatha, Thumunnantha, LyabanthaPrathyaya. Three Lakaras – brief introduction, Lot lakara

Module III

New words and sentences for the communication, Slokas, moral stories, Subhashithas, riddles (Selected from the Pravesha Book)

Module IV

Introduction to classical literature, classification of Kavyas, classification of Dramas - Important five Mahakavyas

Module V

Translation   of   paragraphs   from   Sanskrit   to   English   and   vice   versa

Module VI

Chanakya Neeti chapter III (Part II), Bhagavad Geeta chapter 14 (Part II)

Essential Reading:

1, Praveshaha; Publisher :Samskritabharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085

2, Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad

3, PrakriyaBhashyam written and published by Fr. John Kunnappally

4, Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston

5, Sabdamanjari, R.S. Vadyar and Sons, Kalpathi, Palakkad

6, Namalinganusasanam by Amarasimha published by Travancore Sanskrit series

7, SubhashitaRatnaBhandakara by Kashinath Sharma, published by Nirnayasagarpress

Course Objective: The course will allow students to understandthewriting competency in Tamil literature.

Course outcomes: By the end of the course the students will be able to:
1. Introduction to Tamil Folklore
2. Learning the nuances of Tamil spiritual literature
3. Exposure to the advanced aspects of Tamil grammar
4. Imbibing the spirit of language through familiarising with linguistics, translation and creative writing

அலகு 1
சிற்றிலக்கியங்கள்அறிமுகம்: கலிங்கத்துப்பரணி (பபோர்போடியது), முக்கூடற்பள்ளு
35. நோட்டுபுறவியல்: வரரவிலக்கணம், நோட்டுபுறப்போடல்கள், கரதகள்,
கரதப்போடல்கள், பழமமோழி, விடுகரதகள், கரலகள்.

Introduction to CiRRilakkiyam: Kalingaththupparani (Poor Padiyathu) - MukkdaRpallu 35. Folklore: Definition, Folksongs - Stories – kathaipPaadal - pazhamozhi - vidukathai - kalaikaL.

அலகு 2
பக்திஇலக்கியம்: ஆண்டோள்முழுவரலோறு, திருப்போரவ (1,2,3,4)

அலகு 3
மதோல்கோப்பியம்: மபோருளிலக்கணம் - மோல்லிலக்கணம்

அலகு 4
மமோழிமபயப்பு: மமோழிமபயப்புவரகள்,
மமோழிமபயர்ப்பின்முக்கியதுவமும்பதரவயும், இயந்திரமமோழிமபயர்ப்பு,
மகோள்ரககள், இலக்கியமமோழிமபயர்ப்பு. மமோழியியல்அறிமுகம்:
மமோழியும்மமோழியியலும், பயன்போடுமமோழியின்தன்ரமகள்
,மமோழியியல்துறறகள். பரடப்புஉருவோக்குதல் (கருத்துபரிமாற்றம் -
கவிரதஇலக்கியம்- அறிமுகம், விடுதரலக்குமுன்னும்பின்னும் - நாடகம் - சிறுகதத).

Translation: Types of translation - Importance and need of translation - Machine translation - Principles - Literary translation.
Introduction to Linguistics: Language and Linguistics- Linguistics – Characteristics of applied language – Fields of Linguistics. Creation of creativity (Exchange of ideas - introduction to poetry literature, before and after liberation - drama - short story).

REFERENCES
மு.வரதரோன்" தமிழ்இலக்கியவரலோறு" ௦ஹித்யஅகமடமிபப்ளிபகஷன்ஸ , 2012
மபோன்மணிமோறன் "அபடோன்தமிழ்இலக்கணம் "அபடோன்பப்ளிஷிங்குரூப்,
வஞ்சியூர், திருவனந்தபுரம், 2007. http:/www.tamilvu.org/libirary/libindex.htm.
http:/www.gunathamizh.com/2013/07/blog0post_24.html நோ.வோனமோமரல,
"தமிழர்நோட்டுப்போடல்கள்" நியூமஞ்சுரிபுத்தகமவளியீட்டகம் 1964,2006
நோ.வோனமோமரல "பழங்கரதகளும், பழமமோழிகளும்
"நியூமஞ்சுரிபுத்தகமவளியீட்டகம், 1980,2008

Objectives:
- To expose the students to various genres of English Literature.
- To expose the students to Indian English Writing of different timelines.
- To develop sensibility to read and understand literature and thereby encourage them to be sensitive to the whole spectrum of human experience.

COs	Course Outcomes
CO 1	To demonstrate an ability to critically appreciate any literary text
CO 2	To exhibit an ability to narrate and express their thoughts and idea.
CO 3	To be able to evaluate and relate to common human experiences

Unit-I
Introduction:
Drama : Tragedy & Comedy, Characters, Setting
Prose: Fiction and Non-Fiction
Life Writing.: Biography, Autobiography, Memoirs

Unit-II
Essays:
Shashi Tharoor - A Child's Reading in India
Sarvepalli Radhakrishnan - Gandhian Outlook

Unit-III
 Play: *Silence! The Court is in Session'* by Vijay Tendulkar

Unit-IV
Non-Detail reading:
Karma – Khushwant Singh
Kailash Satyarthi's Nobel Lecture on 10 December 2014 at Oslo City Hall, Norway
Of Mothers, among other things. By A.K. Ramanujan

Unit-V
Critical Appreciation and Creative Writing: Class Activity

Core Reading
- Habib, M.A.R, *Literary Studies, A Norton Guide*, Norton & Co, 2020
- Naik, M.K., *A History of Indian English Literature,* Sahitya Academy

References:
- Tendulkar, Vijay, *Silence! The Court is in Session,* Oxford University Press, 1982
- *Tharoor, Shashi, A Child's Reading in India,* Washington Post, Dec 1991
- *Gandhi Outlook and Techniques -* Ministry of Education, January 1, 1953
- Singh, Khushwant, *Collected Short Stories*, Ravi Dayal Publishers, 1989
- **Nobel Lecture – Audio** [https://www.youtube.com/watch?v=UNZNbcf5Hd8]

Assessment Component	Weightage
Continuous Evaluation (Class Tests, Critical Appreciation, Creative Writing)	20
Mid Term Examination	30
End Semester Examination	50
Total	**100**