SACRED HEART COLLEGE (AUTONOMOUS), THEVARA
KOCHI, KERALA, 682013

CURRICULUM AND SYLLABI

CHOICE BASED COURSE CREDIT AND SEMESTER SYSTEM (CBCSS)

INTEGRATED M SC PROGRAMME IN COMPUTER SCIENCE – DATA SCIENCE (5 YRS)

(Introduced from 2021 Admission Onwards)

BOARD OF STUDIES IN COMPUTER SCIENCE
Sacred Heart College (Autonomous), Thevara, Kochi, Kerala

CONTENTS

FOREWORD

Integrated M. Sc. Programme in Computer Science – Data Science is five years integrated post graduate aided degree programme, designed by Mahatma Gandhi University and approved by the University Grants Commision, which is specialized in the area of Data Science. After successful completion of the programme, the students can explore a wide range of career opportunities such as Data Scientist, Data Engineer, Data Analyst, Data Architect, Machine Learning Engineer, Database Administrator, Business Intelligence Developer and so on. Also, after the successful completion of the five-year programme, the students can involve in, and register themselves for research programmes in Data Science and contribute to the society by working with Corporate Social Responsibility (CSR) projects.

This programme helps the students in understanding and modeling real-life problems through statistical and computational techniques, applying machine learning concepts in applications as well as to lay a strong research foundation in the Data Science and publish quality articles.

Mahatma Gandhi University, has approved conducting the programme in the college towards the middle of academic year 2020-2021. The university, when framing the curriculum for all Integrated Post Graduate Programmes has also included the course IT & Environment that covers various aspects of environmental studies and human rights in an impressive way. The Academic Council of the college has thus decided to implement the University syllabus and conduct the five-year Integrated M. Sc. Programme in Computer Science – Data Science from the academic year 2021-2022 onwards.

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REGULATIONS FOR THE INTEGRATED POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM

2020-2021

INTEGRATED PG PROGRAMS: UNDER MAHATMA GANDHI UNIVERSITY REGULATIONS 2020-2021

1. SHORT TITLE

1.1 These Regulations shall be called Mahatma Gandhi University Regulations (2020) governing Integrated Post Graduate Programmes under Credit Semester System (MGU)

1.2 These Regulations shall come into force from the Academic Year 2020-2021 onwards

2. SCOPE

2.1 The regulation provided herein shall apply to all Integrated Post-Graduate Programmes in the affiliated colleges with effect from academic year 2020-2021 admissions.

3. DEFINITIONS

3.1 **'Academic Committee'** means the Committee constituted by the Vice Chancellor under this regulation to monitor the running of the Integrated Post-Graduate Programmes under the Credit Semester System (MGU IPG CSS2020)

3.2 **'Academic Week'** is a unit of five working days in which distribution of work is organized from day one to day five, with five contact hours of one hour duration each day. A sequence of minimum 18 such academic weeks constitute a semester.

3.3 **'Audit Course'** is a course for which no credits are awarded.

3.4 **'CE'** means Continuous Evaluation (Internal Evaluation)

3.5 **'College Co-ordinator'** means a teacher from the college nomiated by the College Council to look into the matters relating to MGU IPG for Programmes conducted in the College.

3.6 **‘Comprehensive viva-voce’** means the oral examinations conducted by the examiners appointed for the purpose and shall cover all courses of study undergone by a student of the Programme.

3.7 **‘Common Course’** is a core course which is included in more than one programme with the same course code.

3.8 **‘Complementary Course’** is a course which is generally related to the core course.

3.9 **‘Core Course’** means a course which cannot be substituted by any other course.

3.10 **‘Course’** means a segment of subject matter to be covered in a semester. Each Course is to be designed variously under Lectures / Tutorials / Laboratory or Fieldwork / Seminar / Project / Practical Training / Assignments / Viva - voce etc., to meet the effective teaching and learning needs.

3.11 **‘Course Code’** means a unique alpha numeric code assigned to each course of a program.
Course Credit’ One credit of the course is defined as a minimum of one hour lecture / minimum 2 hours lab / field work per week for 18 weeks in a semester. The course will be considered completed only by conducting the final examination.

3.12 **‘Course Credit’** One credit of the course is defined as a minimum of one hour lecture / minimum 2 hours lab / field work per week for 18 weeks in a semester. The course will be considered as completed only by conducting the final examination.

3.13 **‘Course Teacher’** means the teacher of the institution in charge of the course offered in the Programme.

3.14 **‘Credit’** of a course is a numerical value which depicts the measure of the weekly unit of work assigned for that course in a semester.

3.15 **‘Credit Point (CP)’** of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course **CP = GP x Cr**

3.16 **‘Cumulative Credit Point Average (CCPA)’** is the value obtained by dividing the sum of credit points of all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places. CCPA determines the overall performance of a student at the end of a programme.

[CCPA = Total CP obtained / Total Credits of the Programme]

3.17 **'Department'** means any teaching Department in the affiliated college / Institution offering a programme of study approved as per the relevant provisions of the Act / Statutes of the University.

3.18 **'Department Council'** means the body of all teachers of a Department in a college.

3.19 **'Dissertation'** means a long document on a particular subject in connection with the project / research / field work, etc.

3.20 **'Duration of Programme'** means the period of time required for the conduct of the programme. The duration of Integrated Post Graduate Programme shall be 10 semesters spread over 5 academic years.

3.21 **'Elective Course'** means a course, which can be substituted, by an equivalent course from the same subject.

3.22 **'Elective Group'** means a group consisting of elective courses for the programme.

3.23 **'ESE'** means End Semester Evaluation [External Evaluation]

3.24 **'Evaluation'** is the process by which the knowledge acquired by the student is quantified as per the criteria detailed in these regulations.

3.25 **'External Examiner'** is the teacher appointed from other colleges for the valuation of courses of study undergone by the students in a college. The external examiner shall be appointed by the University.

3.26 **'Faculty Advisor'** is a teacher nominated by the Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department of the affiliated College / Institution.

3.27 **'Grade Point [GP]'** – Each letter grade is assigned a 'Grade Point' [GP] which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

3.28 **'Grade Point Average [GPA]'** is an index of the performance of a student in a semester. It is obtained by dividing the sum of the weighted grade points obtained in the semester by the sum of the weights of the course ($GPA=\Sigma WGP/\Sigma W$).

3.29 **'Improvement Course'** is a course registered by a student for improving his/her performance in that particular course, along with the subsequent batch. No improvement will be allowed for VI and X Semesters.

3.30 **'Internal Examiner'** is a teacher nominated by the department concerned to conduct Internal Evaluation.

3.31 **'Letter Grade' or 'Grade'** for a course is a letter symbol [A+, A, B+, B, C, D] which indicates the broad level of performance of a student for a course.

3.33 **'Parent Department'** means the department which offers a particular Integrated Post Graduate programme.

3.34. **'Plagiarism'** is the unreferenced use of other authors' material in dissertations and assignments and is a serious academic offence.

3.36 **'Programme'** means the entire course of study and examinations.

3.37 **'Project'** is a core course in a programme. It means a regular project work with stated credits on which the student undergo a project under the supervision of a teacher in the parent department / any appropriate research center in order to submit a dissertation on the project work as specified. It allows students to work more autonomously to construct their own learning and culminates in realistic, student-generated products or findings.

3.37 **'Repeat Course'** is a course that is repeated by a student for having failed in that course in an earlier registration.

3.38 **'Semester'** means a term consisting of minimum 90 working days, inclusive of examinations, distributed over a minimum of 18 weeks of 5 working days each.

3.39 **'Seminar'** means a lecture given by a student on a selected topic and is expected to train the student in self-study, collection of relevant matter from various resources, editing, document writing and presentation.

3.40 **'Semester Credit Point Average' [SCPA]** is the value obtained by dividing the sum of credit points [CP] obtained by a student in the various courses taken in a semester by the total number of credits for the course in that semester. The SCPA shall be rounded off to two decimal places. SCPA determines the overall performance of a student at the end of a semester
[SCPA = Total CP obtained obtained in the semester / Total Credits for the Semester].

3.41 **'Tutorial'** Tutorial means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

3.42 **'University'** means Mahatma Gandhi University Kottayam, Kerala.

3.43 **'Weight'** is a numeric measure assigned to the assessment units of various components of a course of study.

3.44 **'Weighted Grade Point' [WGP]** is the grade point multiplied by weight. **[WGP=GPxW]**

3.45 **'Weighted Grade Point Average [WGPA]'** is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points by the sum of the weights. WGPA shall be obtained for CE (Continuous Evaluation) and ESE (End Semester Evaluation) separately and then the combined WGPA shall be obtained for each course.

3.46 Words and Expressions used and not defined in this regulation but defined in the Mahatma Gandhi University Act and Statutes shall have the meaning assigned to them in the Act and Statutes.

4. ACADEMIC COMMITTEE

4.1 There shall be an Academic Committee constituted by the Vice Chancellor to manage and monitor the working of MGU IPG CSS2021.

4.2 The Committee consists of:

a) The Vice-Chancellor
b) The Pro-Vice-Chancellor
c) The Registrar
d) The Controller of Examinations
e) Two Teachers nominated from among the Syndicate Members

4.3 There shall be a sub-committee nominated by the Vice Chancellor to look after the day-to-day affairs of the Mahatma Gandhi University Regulations for the Integrated Post Graduate Programmes.

5. PROGRAMME STRUCTURE

Students shall be admitted to Integrated Post Graduate Programme under the various faculties. Medium of instruction shall be English, except for programmes under Faculty of Language and Literature. The programme shall include four types of courses - Core Courses, Complementary Courses, Elective Courses, and Common Courses. There shall be a project / dissertation and comprehensive viva voce as part of core courses for all programmes in the VI and X Semester. The programme shall also include Assignments / Seminars / Practicals/Industrial Visits.

5.1 Elective Courses and Groups

5.1.1 The candidate shall select any one of the elective course for each programme as per the interest of the student, availability of faculty and academic infrastructure of the institution.

5.1.2 The elective courses selected by the College shall be intimated to the Controller of Examinations within two weeks of commencement of the semester in which the elective courses are offered. The elective course selected by the college, on behalf of the students admitted in a particular academic year shall not be changed.

5.2 Project Work

5.2.1 Project work shall be completed in accordance with the guidelines given in the curriculum.

5.2.2 There shall be two projects (one minor and one major). Evaluation for the Minor Project will be done in the Sixth semester and that of Major Project will be done in the X Semester. Project work shall be carried out under the supervision of a teacher of the department concerned.

5.2.3 Major project can be based on a two to three month Internship

5.2.4 A candidate may, however, in certain cases be permitted to work on the project in an Industrial / Research Organization on the recommendation of the supervising teacher.

5.2.5 There shall be an internal assessment and external assessment for the Project Work.

5.2.6 The Project Work shall be evaluated based on the presenation of the project work done by the student, the dissertation submitted and the viva-voce of the project.

5.2.7 The external evaluation of the Project Work shall be conducted by one External examiner from a different college and an internal examiner from the college concerned.

5.3 **Assignments**: Every student shall submit at least one assignment as an internal component for each course.

5.4 **Seminar Lecture**: Every College Going student shall deliver one seminar lecture as an internal component for every course. The seminar lecture is expected to train the student in self-study, collection of materials relevant to

the subject of study from various resources, editing, document writing, and presentation.

5.5 **Test Papers (Internal)**: Every student shall undergo at least one class tests as an internal component for each course.

5.6 No courses shall have more than 5 credits unless otherwise specified.

5.7 Comprehensive Viva-voce

5.7.1 **Comprehensive viva-voce** – shall cover questions from all courses in the programme.

5.7.2 There shall be an external assessment for the comprehensive viva-voce.

6. ATTENDANCE

6.1 The minimum requirement of aggregate attendance during a semester for appearing at the end semester-examination shall be 75%. Condonation of shortage of attendance to a maximum of 15 days in a semester, subject to a maximum of two times during the whole period of the programme may be granted by the University.

6.2 If a student represents his / her institution, University, State or Nation in Sports, NCC, or Cultural or any other officially sponsored activities such as College Union, University Union, etc, he / she shall be eligible to claim the attendance for the actual number of days participated, subject to the attendance certificate from concerned authorities and based on the specific recommendations of the Head of the Department or teacher concerned.

6.3 Those who could not register for the examination of the particular semester due to shortage of attendance may repeat the semester along with junior batches, without considering sanctioned strength, subject to the existing University Rules and Clause 7.2 of this regulation.

7. REGISTRATION / DURATION

7.1 A student shall be permitted to register for the programme at the time of the admission.

7.2 A student who has registered for the programme shall complete the Programme within a period of Seven years from the date of commencement of the programme.

8. ADMISSION

8.1 The admission to all regular IPG programmes shall be through Centralized Allotment Process (CAP) of the Mahatma Gandhi University, unless otherwise specified.

8.2 The eligibility criteria for admission to IPG Programmes shall be published by the University along with the notification for admission.

8.3 There shall be provision for inter-collegiate transfer from second semester onwards within a period of four weeks from the date of commencement of the semester.

8.4 There shall be provision of Credit Transfer, subject to the conditions stipulated by the Board of Studies / Expert Committee concerned.

9. ADMISSION REQUIREMENTS

9.1 Students admitted to these Programmes are governed by the eligibility requirements specified by Mahatma Gandhi University Regulations in force.

10. PROMOTION

10.1 A student who registers for a particular semester examination shall be promoted to the next semester. However, a student who registers for the IX Semester should have completed all the courses successfully up to VI Semester.

10.2 A student having 75% attendance for the semester and fails to register for end of semester examination of that particular semester shall be allowed to register notionally and is promoted to the next semester, provided application for notional registration shall be submitted before the University within 15 days from the commencement of the next semester.

11. EXAMINATIONS

11.1 There shall be University examinations at the end of every semester.

11.2 Practical examinations shall be conducted by the University at the end of even semesters as prescribed in the syllabus of the particular programme. The number of examiners for the practical examinations shall be prescribed by the Board of Practical Examinations of the Programme. The odd semester's practical examination shall be internal. The ratio of the credit for odd semester (Internal) and even semester (External) practical examination shall be 1:3.

11.3 End-Semester Examinations: The examinations shall normally be conducted at the end of each semester using Question Bank developed by MG University.

11.4 There shall be one end-semester examination of 3-hours duration for each lecture based and practical course.

11.5 A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Different types of questions shall have different weightage.

12. EVALUATION AND GRADING

12.1 Evaluation: The evaluation scheme for each course shall contain two parts: (a) End Semester Evaluation [ESE] [External Evaluation] and (b) Continuous Evaluation [CE][Internal Evaluation]. 25% weightage shall be given to the internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is 1:3. Both End Semester Evaluation [ESE] and Continuous Evaluation [CE] shall be carried out using Direct Grading system.

12.2 Direct Grading: The direct grading for CE [Internal] and ESE [External Evaluation] shall be based on 6 letter grades **[A+, A, B, C, D and E]** with numerical values of **5, 4, 3, 2, 1 and 0** respectively.

12.3 Grade Point Average [GPA]: Internal and External components are separately graded and the combined grade point with weightage 1 for internal and 3 for external shall be applied to calculate the Grade Point Average [GPA] for each course. Letter grade shall be assigned to each course based on the categorization provided in table 12.6.

12.4 Internal Evaluation for Programme: The Internal Evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars, seminar lectures, lab skills, records, viva-voce, etc.

12.5 Components for Internal [CE] and External Evaluation [ESE]: Grades shall be given to the evaluation of theory / practical / project / comprehensive viva voce and all internal evaluations are based on the Direct Grading System. Proper guidelines shall be prepared by the Board of Studies / Expert Committee for evaluating the assignment, seminar, practical, project and comprehensive viva-voce within the framework of the regulation.

12. 6 There shall be separate minimum grade point for internal evaluation.

12.7 The model of the components and its weightages for Continuous Evaluation [CE] and End Semester Evaluation [ESE] are shown below:

a) for Theory [CE][Internal]

No.	Components	Weightage
i.	Assignment	1
ii.	Seminar	2
iii.	Test paper	2
	TOTAL	**5**

b) **For Theory (ESE) (External)**

Evaluation is based on the pattern of question specified in 12.16.5

c) **For Practical (CE) (Internal)**

Components	Weightage
Written/Lab test	2
Lab involvement and Record	1
Viva	2
Total	**5**

(The components and the weightage of the components of the practical (Internal) can be modified by the concerned BOS without changing the total weightage 5.)

d) **For Project - Minor**

Components	Weightage
Relevance of the topic and analysis	2
Project content and presentation	2
Project Viva	1
Total	**5**

(The components and the weightage of the components of the Project (Minor) can be modified by the concerned BOS without changing the total weightage 5.)

e) **For Project - Major**

Components	**Weightage**
Relevance of the topic and analysis	2
Project content and presentation	2
Project Viva	1
Total	**5**

(The components and the weightage of the components of the Project (Major) can be modified by the concerned BOS without changing the total weightage 5.)

f) **Comprehensive viva-voce (ESE) (External)**

Components	**Weightage**
Subject Knowledge	3
Presentation/ communication	2
Total	**5**

(Weightage of the components of the Comprehensive viva-voce (external) shall not be modified.)

12.8 **All grade point averages shall be rounded to two decimal points**.

12.9 To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination.

12.10 There shall not be any chance for improvement for internal grade. However, the students can redo the same.

12.11 The **course teacher** and the **faculty advisor** shall maintain the academic record of each student registered for the course which shall be forwarded to the University through the Principal and a copy should be kept in the college for verification for at least two years after the student completes the programme.

12.12 **External Evaluation**. The external examination in theory courses is to be conducted by the University at the end of the every semester. **The answers may be written in English or Malayalam except those for the Faculty of Languages.** The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination preferable through Centralized Valuation.

12.13. Photocopies of the answer scripts of the external examination shall be made available to the students on request as per the rules prevailing in the University.

12.14 The question paper should be strictly on the basis of model question paper set and directions prescribed by the BOS / Expert Committee.

12. 15 **Pattern of Questions**

12.15.1Questions shall be set to assess knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. Due weightage shall be given to each module based on content/teaching hours allotted to each module.

12.15.2 The question setter shall ensure that questions covering all skills are set.

12.15.3 A question paper shall be a judicious mix of short answer type, short essay type/problem solving type and long essay type questions.

12.15.4 The question shall be prepared in such a way that the answers can be awarded A+. A. B, C. D, E grades

12.15.5 Weight: Different types of questions shall be given different weights to quantify their range as follows:

Sl No.	**Type of Questions**	**Weight**	**Number of questions to be answered**
1.	Short Answer type questions	1	8 out of 10
2.	Short essay/problem solving type questions	2	6 out of 8
3.	Long Essay type questions	5	2 out of 4

12. 16 Pattern of question for practical.

The pattern of questions for external evaluation of practical shall be prescribed by the Board of Studies.

12. 17 Direct Grading System

Direct Grading System based on a 7-point scale is used to evaluate the Internal and External examinations taken by the students for various courses of study.

Grade	Grade	Range
A+	5	4.5 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.00 to 1.99
E	0	0.00

12.18 Performance Grading

Students are graded based on their performance (GPA/SGPA/CGPA) at the examination on a 7-point scale as detailed below.

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good (Average)
2..50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal (pass)
Up to 1.99	D	Deficient (Fail)

12.19 Separate minimum is required for internal evaluation (C grade) for a pass, but a minimum C grade is required for a pass in an external evaluation. However, a minimum C grade is required for pass in a course.

12.20 A Student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.

12.21 **Improvement of Course**- The candidates who wish to improve the grade/grade point of the external examination of a course/courses he/she has passed can do the same by appearing in the external examination of the semester concerned along with the immediate junior batch.

12.22 **One Time Betterment Programme**- A candidate will be permitted to improve the **CCPA** of the programme within a continuous period of four semesters immediately following the completion of the programme allowing only once for a particular semester. The **CCPA** for the betterment appearance will be computed based on the **SCPA** secured in the original or betterment appearance of each semester whichever is higher.
If a candidate opts for the betterment of **CCPA** of a programme, he/she has to appear for the external examination of the entire semester(s) excluding practicals/project/comprehensive viva-voce. One time betterment programme is restricted to students who have passed in all courses of the programme at the regular (First) appearance.

12.23 **Semester Credit Point Average (SCPA) and Cumulative Credit Point Average (CCPA) Calculations.** The **SCPA** is the ratio of sum of the credit points of all courses taken by a student in the semester to the total credit for that semester. After the successful completion of a semester, **Semester Credit Point Average (SCPA)** of a student in that semester is calculated using the formula given below.

Semester Credit Point Average – SCPA(S_j) = $\sum (C_i \times G_i) / \sum C_i$
(SCPA = Total Credit Points awarded in a semester /
Total Credits of the semester)

Where **'S_j'** is the **j^{th}** semester, **G_i** is the grade point scored by the student in the **i^{th}** course **c_i** is the credit of the **i^{th}** course.

Cumulative Credit Point Average (CCPA) of a Programme is calculated using the formula:-

Cumulative Credit Point Average – (CCPA) = $\sum (C_i \times S_i) / \sum C_i$
(**CC**
PA = Total credit Points awarded in all semesters/Total
credits of the Programme)

Where **'C_i'** is the credits for the **i^{th}** semester, **S_i** is the **SGPA** for the **i^{th}** semester. The SCPA and **CCPA** shall be rounded off to 2 decimal points.

For the successful completion of semester; a student shall pass all courses and score a minimum **SCPA** of 2.0. However, a student is permitted to move to the next semester irrespective of her/his **SCPA**.

13. GRADE CARD

13.1 The university under its seal shall issue to the students, a consolidated grade card on completion of the programme, which shall contain the following information.

a Name of the University
b Name of College
c Title of the PG Programme
d Name of the Semesters
e Name and Register Number of the student
f Code, Title, Credits and Max GPA (Internal, External & Total) of each course (Theory & Practical), Project, viva etc. in each semester.
g Internal, external and total grade, Grade Point (G), Letter Grade and Credit Point (P) in each course opted in the semester.
h The total credits and total credit points in each semester.
i Semester Credit Point Average (SCPA) and corresponding Grade in each semester
j Cumulative Credit Point Average (CCPA), Grade for the entire programme.
k Separate Grade card will be issued at the request of candidates and based on University Guidelines issued from time to time.
l Details of description of evaluation process-Grade and Grade Point as well as indicators, calculation methodology of SCPA and CCPA as well as conversion scale shall be shown on the reverse side of the grade card.

14. AWARD OF DEGREE (Graduate/ Post Graduate)

The successful completion of all the courses with ‘C’ grade within the stipulated period shall be the minimum requirement for the award of the degree.

15. MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Vice-Chancellor to monitor the internal evaluations conducted by institutions.

16. POSITION CERTIFICATE

The University shall publish the list of top 10 candidates for each programme after the publication of the programme results. Position certificates shall be

issued to candidates who secure positions from 1st to 3rd in the list. Position certificate shall be issued to candidates on their request.

Candidates shall be ranked in the order of merit based on the CCPA secured by them. Grace grade points awarded to the students shall not be counted for fixing the rank/position. Rank certificate and position certificate shall be signed by the Controller of Examinations.

17. GRIEVANCE REDRESSAL COMMITTEE

17.1 Department Level: The College shall form a Grievance Redressal Committee in each Department comprising of the course teacher and one senior teacher as members and the Head of the Department as Chairperson. The Committee shall address all grievances relating to the internal assessment grades of the students.

17.2 University Level: The University shall form a Grievance Redressal Committee as per the existing norms.

18. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice-Chancellor shall, for a period of three year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

19. REPEAL

The Regulations now in force in so far as they are applicable to programmes offered by the University and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the existing regulations and these regulations relating to the Credit Semester System in their application to any course offered in a College, the latter shall prevail.

20. CREDITS ALOTTED FOR PROGRAMMES AND COURSES

20.1 Total credit for each programme shall be 200

20.2 Semester-wise total credit can vary from 16-25

20.3. The Minimum credit of a course is 1 and maximum credit is 5.

21. COMMON COURSE

If a course is included as a common course in more than one programme, its credits shall be same for all programmes

22. COURSE CODES

The course codes assigned for all courses (core course, elective courses, common courses etc.) shall be unique.

23. Models of distribution of courses, course codes, type of the course, credits, teaching hours for a programme are given in the following tables.

Courses	Credits
Core	144
Complementary - 1	16
Complementary - 2	16
Elective 4	12
Language English	8
Second Language	4
Total	200

Appendix

Evaluation first stage – Both Internal and External (to be done by the teacher)

Grade	Grade Points	Range
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

The final Grade range for courses, SGPA and CGPA

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good
2..50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal

Up to 1.99	**D**	**Deficient (Fail)**

Theory-External- ESE

Maximum weight for external evaluation is 30. Therefore Maximum Weighted Grade Point (WGP) is 150

Type of Question	**Qn. No's**	**Grade Awarded**	**Grade point**	**Weights**	**Weighted Grade Point**
Short Answer	1	A+	5	1	5
	2	-	-	-	-
	3	A	4	1	4
	4	C	2	1	2
	5	A	4	1	4
	6	A	4	1	4
	7	B	3	1	3
	8	A	4	1	4
	9	B	3	1	3
	10	-	-	-	
Short Essay	11	B	3	2	6
	12	A+	5	3	10
	13	A	4	2	8
	14	A+	5	2	10
	15	-	-	-	-
	16	-	-	-	-
	17	A	4	2	8
	18	B	3	2	6
Long Essay	20	A+	5	5	25
	21	-	-	-	-
	22	-	-	-	-
	23	B	3	5	15
			TOTAL	30	117
Calculation:Overall Grade of the theory paper = Sum of Weighted Grade Points/ Total weight 117/30 = 3.90 = Grade B+					

Theory-Internal- CE

Maximum weight for Internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	**Weight (W)**	**Grade Awarded**	**Grade Point (GP)**	**WGP = W * GP**	**Overall Grade of the course**
Assignment	1	A	4	4	**WGP /Total**
Seminar	2	A+	5	10	

Test Paper 1	2	A+	5	10	**weight = 24 / 5 =**
Total	**5**			**24**	**A+**

Practical - External- ESE

Maximum weight for Internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	**Weight (W)**	**Grade Awarded**	**Grade Point (GP)**	**WGP = W * GP**	**Overall Grade of the course**
Assignment	2	A	4	8	**WGP /Total weight = 23 / 5 = 4.60**
Seminar	1	A+	5	5	
Test Paper 1	2	A+	5	10	
Total	**5**			**23**	**A+**

Practical-Internal- CE

Maximum weight for Internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	**Weight (W)**	**Grade Awarded**	**Grade Point (GP)**	**WGP = W * GP**	**Overall Grade of the course**
Written / Lab test	2	A	4	8	**WGP /Total weight = 17 / 5 = 3.40**
Lab involvement and Record	1	A+	5	5	
Viva	2	C	2	4	
Total	**5**			**17**	**B**

Project – Major

Maximum weight for Internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	**Weight (W)**	**Grade Awarded**	**Grade Point (GP)**	**WGP = W * GP**	**Overall Grade of the course**
Relevance	2	C	2	4	**WGP /Total**

of the topic & Analysis					**weight = 17 / 5 = 3.9**
Project content & presentation	2	A+	5	10	
Project viva-voce	1	B	3	13	
Total	**5**			**17**	**B+**

Project – Minor

Maximum weight for Internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Comprehensive viva-voce-External- ESE

Components	**Weight (W)**	**Grade Awarded**	**Grade Point (GP)**	**WGP = W * GP**	**Overall Grade of the course**
Comprehensive viva-voce	2	B	3	6	**WGP /Total weight = 21 /5 = 4.2**
Project Content and presentation	2	A+	5	10	
	1	A+	5	5	
Total	**5**			**21**	**A**

Maximum weight for Internal evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) IS 25.

Components	**Weight (W)**	**Grade Awarded**	**Grade Point (GP)**	**WGP = W * GP**	**Overall Grade of the course**
Comprehensive viva-voce	5	A+	5	25	**WGP /Total weight = xxxx**
Total	**5**			**25**	**xxxxxx**

Evaluation second stage – (To be done by the University)

Consolidation of the Grade (GPA) of a Course PC-1

The End Semester Evaluation (ESE) (External Evaluation) grade awarded for the course PC-1 is A and its continuous Evaluation (CE) (Internal Evaluation) grade is A. The consolidated grade for the course PC-1 is as follows.

Evaluation	Weight	Grade awarded	Grade Points awarded	Weighted Grade Point
External	3	A	4.20	12.6
Internal	1	A	4.40	4.40
Total	4			17
Grade of a course	GPA of the course = total weighted Grade Points/ Total Weight **17 / 4 = 4.25 = Grade A**			

Evaluation Third Stage – (To be done by the University)

Semester Grade Point Average (SGPA)

Course code	Title of the course	Credits (C)	Grade Awarded	Grade Points (G)	Credit Points (CP = C X G)
01	PC-1	5	A	4.25	**21.25**
02	----	5	A	4.00	**20.00**
03	----	5	B+	3.80	**19.00**
04	----	2	A	4.40	**8.80**
05	----	3	A	4.00	**12.00**
Total		**20**			**81.05**
SCPA	**Total credit points/ Total credits = 81.05 / 20 = 4.05 = Grade- A**				

Evaluation- Fourth Stage- (To be done by the University)

Cumulative Grade Point Average (CGPA)

If a candidate is awarded three A+ grades in Semester 1 (SGPA of semester 1), Semester 2 (SGPA of Semester 2) and Semester 4 (SGPA of Semester 4) and a B grade in semester 3 (SGPA of semester 3). Then the CGPA is calculated as follows.

Semester	Credit of the Semesters	Grade awarded	Grade Point (SCPA	Credit Points
I	20	A+	4.50	90
II	20	A+	4.60	92
III	20	B	3.00	60
IV	20	A+	4.50	90

TOTAL	**80**			**332**
CGPA = Total credit points awarded / Total credit of all semester = 332 / 80 = 4.15 (which is in between 4.00 and 4.49 in 7 – point scale). Therefore the overall Grade awarded in the programme is A				

Conversion of CGPA into percentage of marks
CGPA x 20
eg. CGPA 4.2= 4.2x20= 84.00%

The curriculum and the "Mahatma Gandhi University Regulations Governing Post Graduate Integrated Programmes Under Credit Semester System 2020" have since been uploaded in the website- www.mgu.ac.in

PROGRAMMES OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

PROGRAMME OUTCOMES

Outcome	Outcome Description
PO1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO3	Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.
PO4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

PROGRAMME SPECIFIC OUTCOMES

Outcome	Outcome Description
PO1	Understand the theoretical and practical aspects of computer science and develop competing problem solving and implementation skills.
PO2	Model the real-life problem through the statistical, mathematical and computational techniques and find robust solutions.
PO3	Understand the core phase of data science pipeline and machine learning concepts to develop data driven analytical applications.
PO4	Develop a strong research orientation to understand the problems in computer science and carryout the research process effectively to bring the results and quality research articles.

Integrated M.Sc. Programme in Computer Science - Data Science
Syllabus and Curriculum of the Programme Semester 1 to 10

Semester I

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	IEN1CC01	English 1	5	5		Theory	Common	4	90
2	ICSC1CR2	Programming in C	4	4		Theory	Core	3	72
3	ICSC1CR3	Introduction to Computers	3	3		Theory	Core	3	54
4	ICSC1CR4	Database Management Systems	3	3		Theory	Core	3	54
5	ICSC1CM5	Graph Theory and Operations Research	4	4		Theory	Complementary	4	72
6	ICSC1CP6	Software Lab I	6		6	Lab	Core Practical	4	108
TOTAL			**25**	**19**	**6**			**21**	**450**

Semester II

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	IML/ IHN2CC01	Second Language	5	5		Theory	Common	4	90
2	ICSC2CR2	Object Oriented Programming Using C++	3	3		Theory	Core	3	54
3	ICSC2CR3	Data Structures using C++	3	3		Theory	Core	3	54
4	ICSC2CR4	Operating Systems	4	4		Theory	Core	4	72
5	ICSC2CM5	Linear Algebra	4	4		Theory	Complementary	4	72
6	ICSC2CP6	Software Lab II	6		6	Lab	Core Practical	4	108
		TOTAL	**25**	**19**	**6**			**22**	**450**

Semester III

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSD3CR1	Introduction to Data Science	4	4		Theory	Core	4	72
2	ICSC3CR2	Programming in Python	3	3		Theory	Core	3	54
3	ICSC3CR3	R Programming and Mathematics for Artificial Intelligence	4	4		Theory	Core	3	72
4	ICSC3CR4	Computer Organization and Architecture	4	4		Theory	Core	4	72
5	ICSD3CM5	Probability and Statistics	4	4		Theory	Complementary	4	72
6	ICSD3CP6	Software Lab III: Python and R Programming	6		6	Lab	Core Practical	2	108
TOTAL			**25**	**19**	**6**			**20**	**450**

Semester IV

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	IEN4CC01	English II	5	5		Theory	Common	4	90
2	ICSD4CM2	Probability Distributions and Statistical Inference	4	4		Theory	Complementary	3	72
3	ICSC4CR3	Data Mining	4	4		Theory	Core	4	72
4	ICSC4CR4	Software Engineering	4	4		Theory	Core	3	72
5	ICSC4CR5	Basics of Artificial Intelligence	4	4		Theory	Core	3	72
6	ICSD4CMP6	Complementary Lab: R Programming For Statistical Tools	2		2	Lab	Complementary Practical	2	36
7	ICSD4CP7	Software lab IV	2		2	Lab	Core Practical	1	36
TOTAL			**25**	**21**	**4**			**20**	**450**

Semester V

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSC5CR1	Principles of Machine learning	3	3		Theory	Core	4	54
2	ICSC5CR2	Web Application Development Using PHP	4	4		Theory	Core	3	72
3	ICSC5CR3	Programming in Java	4	4		Theory	Core	3	72
4	ICSC5CR4	IT and Environment	3	3		Theory	Core	4	54
5	ICSD5PR5	Project Minor - Phase I	3		3		Core Project Minor		54
6	ICSD5CP6	Software Lab V: Java and PHP	8		8	Lab	Core Practical	3	144
TOTAL			**25**	**14**	**11**			**17**	**450**

Semester VI

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSC6CR1	Linux and Shell Programming	3	3		Theory	Core	3	54
2	ICSC6CR2	Computer Networks	4	4		Theory	Core	4	72
3	ICSD6CR3	Mobile Application Development using Kotlin	4	4		Theory	Core	4	72
4	ICSC6EA1 /2/3	Elective 1 [Bunch A]	3	3		Theory	Core Elective	3	54
5	ICSD6PR4	Project Minor Phase II	7		7	Lab	Core Project Minor	4	126
6	ICSD6CP5	Software Lab VI: Mobile Application Development using Kotlin	4		4	Lab	Core Practical	2	72
TOTAL			**25**	**14**	**11**			**20**	**450**

Semester VII

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSC7CR1	Computational Mathematics	4	4		Theory	Core Course	4	72
2	ICSD7CR2	Applied Statistics for Data Science	4	4		Theory	Core Course	4	72
3	ICSD7CR3	Advanced Python Programming for Data Science	4	4		Theory	Core Course	4	72
4	ICSD7CR4	Data Engineering in Data Science	4	4		Theory	Core Course	3	72
5	ICSD7CP5	Software Lab VII: Python Programming Lab for data Science	5		5	Lab	Core Practical	3	90
6	ICSD7CP6	Software Lab VIII: Data Engineering Lab	4		4	Lab	Core Practical	2	72
TOTAL			**25**	**16**	**9**			**20**	**450**

Semester VIII

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSD8EB1 /2	Elective 2 [Bunch B]	4	4		Theory	Core Elective	4	72
2	ICSC8CR1	Advanced Deep Learning Techniques	4	4		Theory	Core	4	72
3	ICSD8CR2	Data Visualization	4	4		Theory	Core	4	72
4	ICSD8EC1 /2	Elective 3 [Bunch C]	4	4		Theory	Core Elective	4	72
5	ICSD8CP3	Software Lab IX : Deep Learning Lab using R	4		4	Lab	Core Practical	2	72
6	ICSD8CP4	Software Lab X : Data Visualization Lab using Tableau	5		5	Lab	Core Practical	2	90
TOTAL			**25**	**16**	**9**			**20**	**450**

Semester IX

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSD9ED1 /2	Elective 4 [Bunch D]	4	4		Theory	Core Elective	4	72
2	ICSD9CR1	Text Analytics & Natural Language Processing	4	4		Theory	Core	3	72
3	ICSD9CR2	Web Analytics	4	4		Theory	Core	4	72
4	ICSC9EE1 /2	Elective 5 [Bunch E]	4	4		Theory	Core Elective	4	72
5	ICSD9CP3	Software Lab XI : NLP using R/Python	4		4	Lab	Core Practical	2	72
6	ICSD9PR4	Case study and Minor project	5		5	Lab	Core Project Minor	3	90
TOTAL			**25**	**16**	**9**			**20**	**450**

Semester X

Sl. No	Course Code	Title	Hrs / Week	Theory Hrs/ Week	Lab Hrs/ Week	Lab / Theory	Type of Course	Credits	Total Hours
1	ICSDXPR1	Major Project	25		25	Lab	Core Project Major	16	450
2	ICSDXVV2	Comprehensive Viva Voce				Lab	Core Viva Voce	4	
TOTAL			**25**		**25**			**20**	**450**

Electives

Bunch A	
ICSC6EA1	Cloud Computing
ICSC6EA2	Full stack programming Techniques
ICSC6EA3	Predictive Analytics
Bunch B	
ICSD8EB1	Advanced DBMS
ICSD8EB2	Business Intelligence & Analytics
Bunch C	
ICSD8EC1	Image and Video Analytics
ICSD8EC2	Geospatial Analysis
Bunch D	
ICSD9ED1	Healthcare data Analytics
ICSD9ED2	Social media Analytics
Bunch E	
ICSC9EE1	Block Chain Technology
ICSC9EE2	Big Data Analytics

TOTAL CREDITS FROM FIRST SEMESTER TO TENTH SEMESTER: 200

Semester I

Sl. No.	Course Code	Title	Hrs./ Week	Credits	Total hours
1	IEN1CC01	English - I (T)	5	4	90
2	ICSC1CR2	Programming in C (T)	4	3	72
3	ICSC1CR3	Introduction to Computer (T)	3	3	54
4	ICSC1CR4	Database Management Systems (T)	3	3	54
5	ICSC1CM5	Graph Theory and Operations Research (T)	4	4	72
6	ICSC1CP6	Software Lab I (L)	6	4	108
		Total	25	21	450

Course Title : Communication Skills in English (Common)
Course Code : IEN1CC01
Credits : 4
Total Hours : 90

As approved by Bos of English (UG)

Module 1: Speech Sounds (18 Hrs)
Phonemic symbols – Vowels – Consonants – Syllables – Word stress – Stress in polysyllabic words – Stress in words used as different parts of speech – Sentence stress – Weak forms and strong forms – Intonation – Awareness of different accents: American, British and Indian – Influence of the mother tongue.

Module 2: Listening (18 Hrs)
Active listening – Barriers to listening – Listening and note taking – Listening to announcements – Listening to news on the radio and television.

Module 3: Speaking (36 Hrs)
Word stress and rhythm – Pauses and sense groups – Failing and rising tones – Fluency and pace of delivery – Art of small talk – Participating in conversations – Making a short formal speech – Describing people, place, events and things – Group discussion skills and telephone skills.

Module 4: Reading (18 Hrs)
Reading: theory and practice – Scanning – Surveying a textbook using an index – reading with a purpose – making predictions – understanding text structure – locating main points – making inferences – reading graphics – reading critically – reading for research.

CORE TEXT:
V. Sasikumar, P Kiranmai Dutt and Geetha Rajeevan., Communication Skills in English. Cambridge University Press and Mahatma Gandhi University.

FURTHER READING:

1. A Course in Listening and Speaking I & II – Sasikumar V., Kiranmai Dutt and Geetha Rajeevan., New Delhi: CUP, 2007
2. Study Listening: A Course in Listening to Lectures and Note-taking., Tony Lynch., New Delhi: CUP, 2008
3. Study Speaking: A Course in Spoken English for Academic Purposes, Kenneth, Joan Maclean and Tony Lynch, New Delhi: CUP, 2008
4. Study Reading: A course in Reading Skills for Academic Purposes., Glendinning, Eric H and Beverly Holmstrom., New Delhi: CUP, 2008
5. Communication Studies., Sky Massan, Palgrave Macmillan

Course Title : Graph Theory and Operations Research (Complementary)
Course Code : ICSC1CM5
Credits : 4
Total Hours : 72

As approved by Bos of Mathematics (UG)

Module 1: Graphs (18 hrs)
Graphs and Graph Models, Graph Terminology and Special types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths.
Text 1 Chapter 8 (Sections 8.1, 8.2, 8.3, 8.4 and 8.5 only)

Module II: Trees (18 hrs)
Introduction to Trees, Application of Trees, Tree Traversal, and Spanning Trees.
Text 1 Chapter 9 (Sections 9.1, 9.2, 9.3 and 9.4 only)

Module III: Linear programming problems (18 hrs)
Mathematical formulation of a L.P.P., General linear programming problems, solution of a L.P.P, graphical method for solving a L.P.P.
Simplex Method: Stack and surplus variables- reduction of any feasible solution to a basic feasible solution. Unbounded solution. Optimality conditions- artificial variable techniques- Big M method.

Module IV: Transportation & Assignment Problems (18 hrs)
Transportation model- solution by simplex method- north west corner rule, lowest cost entry method, Vogel method, MODI method, degeneracy, assignment problems.

Text Books:

1. Kenneth H Rosen ; Discrete Mathematics And Its Applications ; 6^{th} Edition ; Tata Mc Graw-Hill Publishing Company Limited

2. Belly E Gillet – Introduction to Operations Research (A Computer Oriented Arithmetic Approach) (Tata Mc. GrawHill)

Course Title : Programming in C (Core)
Course Code : ICSC1CR2
Credits : 3
Total Hours : 54

Course Objectives

On completion of the course, the student:

- will be able to write a complete C program
- will be able to use decision making statements and looping structures
- will have a clear concept on one-dimensional, two-dimensional arrays, modular programming using user defined functions
- will get a clarity on concept of strings, structures and Unions
- should be able to use files for input and output
- will get basic ideas on dynamic storage allocation and command line arguments

Module 1: (14 Hours)

Algorithm and flow chart (structure, desirable qualities, simple examples (sequential, branching, and iterative)). Basic concepts in machine language program and program execution, assembly language program and assembler, high level language program and translators (compilers and interpreters). Procedural programming paradigm – examples. Steps in developing a program – (problem analysis algorithm design, coding, debugging, testing, documentation). Approaches – top down and bottom-up approaches. C Language – structure of a C program – simple sequential program. Role of editor. Compilation, linking and execution under Windows and Linux. IDEs. Types of errors.

Module 2: (12 Hours)

Keywords, constants, variables, data types and variable names, assignment statement. Operators and expressions (including increment, decrement and sizeof()), precedence and order of execution, mixed mode expressions and type conversions. Elementary ideas in function (C program as a collection of functions), main function. Formatted input and output. Simple sequential programs.
Decision making: The goto statement, if, if-else, nesting of if, else if ladder and switch statement, conditional expression. Example programs based on decision making.

Module 3 : (14 Hours)

Control Statements: The while loop, the do while loop, the for loop, nesting of loops, the break statement and continue statement. Example programs.
Functions, basics, prototype, parameter passing, storage classes, recursion. Built-in functions. Example programs.

Module 4: (16 Hours)

Arrays, arrays and functions, Strings, string operations and algorithms, string functions in C. example programs using arrays and strings (including simple search and sort, matrix operations). Pointers – basic concepts, pointer arithmetic, pointers and arrays, pointers and strings, pointers and functions. Dynamic memory allocation, simple programs using pointers.

Module 5: (16 Hours)

Structures – basics, array of structures, pointers and structures, structure and function, self – referential structures, union, programs using structures.

The Pre-processor: File Inclusion, Macro definition and substitution, macros with arguments, nesting of macros, conditional compilation. (Simple illustrative examples)

File Management: Defining and opening a file, closing files, input/output operations on files, predefined streams, error handling during I/O operations, Random Access to files, Command line arguments. Simple examples of file creation.

Book of Study:

1. Programming in ANSI C: E Balagurusamy 8th edition MC GRAW HILL INDIA publishers.

References:

1. Programming with C: Byron S Gottfried, Schaum's Outline series, 4th edition.
2. Programming in C: Ashok n Kamthane, Pearson Education, 3rd edition
3. Let us C: Yeshwant Kanetkar 16th edition BPB publishers

Course Title : Introduction to Computers (Core)
Course Code : ICSC1CR3
Credits : 3
Total Hours : 54

Course Objectives

After successful completion of the course the students will be able to:

- understand basic functions of computer hardware, software components including memory & operating systems
- understand the concept of networking and internet
- understand IT and its impact on society

Module 1: Introduction (8 Hrs)

Introduction: Functional units of a computer system, Different types of computers, Computer Software and Hardware, Types of Software (System software and Application software).

Characteristics of Computers. Computer Languages (Machine, Assembly, and High-Level Languages – 3GL, 4GL, 5GL)

Module 2: Interaction with Computers (12 Hrs)

Interaction with Computers, Data Processing and Storage Information: Input devices, Output devices, Representation of Data, Processing of Data, the CPU, Memory, different types of RAM and ROM, types of storage devices (Magnetic storage devices, Optical storage devices, Solid State storage devices), SSD – types, performance, benefits; Graphics Processing Unit (GPU)

Module 3: Introduction to Operating System, Networking (12 Hrs)

Introduction to Operating Systems, Networking: Definition of an Operating System, Different types of PC Operating systems, File Management (file access methods, file operations, file naming). Computer Network: Basic elements of communication system, Data transmission modes, data transmission speed, data transmission media (twisted pair wire, coaxial cable, Microwave system, Communication satellite, Optical fibres), Modems, Categories of networks (PAN, CAN, LAN, WAN, MAN).

Module 4: Internet (12 Hrs)

Internet: Definition, Working of internet, Major features of internet, Major services (WWW, Electronic mail, FTP, Chat, Instant messaging, Telnet, Usenet News, Online Services, Peer-to-Peer services), TCP/IP, URL's, Web Browsers, Major elements of Internet Search engines, Popular Search Engines, Uses of the Internet, WWAN, Academic service (INFLIBNET, NPTEL, NICNET, BRNET)

Module 5: Introduction to Cyber World (10 Hrs)

Introduction to Cyber World: Cyber space, introducing cyber laws, scope of cyber laws (E-commerce, online, contracts, IPRs (copyrights, trademarks, and software patenting); cyber ethics, Cyber addiction – types of internet addiction, causes of cyber addiction, effects of Internet addiction, effects of internet addiction; Cybercrimes – Introduction, categories of cybercrime, types of cybercrimes.

Books of Study:

1. Peter Norton's – Introduction to Computers, Sixth edition, Published by Tata McGraw Hill
2. P.K Sinha & Priti Sinha – Computer Fundamentals, Fourth edition, BPB Publications.
3. Barkha & U. Rama Mohan – Cyber Law Crimes, Asia Law House, New Edition

References:

1. V Rajaraman – Introduction to Information Technology, Prentice-Hall of India.
2. Harley Hahn – The Internet Complete Reference, Tata McGraw Hill edition
3. Dr. Farooq Ahamad – Cyber Law in India (Law of Internet), New Era Law publication.

Course Title : Database Management Systems (Core)
Course Code : ICSC1CR4
Credits : 3
Total Hours : 54

Course Objectives

On completion of the course, the student should have:

- a clear concept on databases, data models, architecture and components od DBMS
- learnt the concept of entity, attributes, associations and relationships concept of tables and its properties, table creation and manipulation of tables and databases using SQL.
- learnt the concept of DDL and DML facilities.

Module 1: Database Management System Concepts (9 Hrs)
Introduction, Significance of Databases, Advantages of Database approach; Data Independence; Components of Database Systems, Classification of Users, the Database Administrator (DBA) and his responsibilities; advantages and disadvantages of Database Management System.

Module 2: Entity attributes and Data Models for a Database (9 Hrs)
Entities and their Attributes, different types of Entities and Attributes, Association and relationships and their different types. E-R Diagrams: Data Models, Hierarchical, Network and Relational data models. Benefits and Application of each Data Model.

Module 3: DBMS Architecture and Schema, Data Dictionary (10 Hrs)
Three Level Architecture of DBMS, The External Level or Subschema, The Conceptual Level or Conceptual Schema, The Internal Level or Physical Schema, Data Definition Language, Data Manipulation Language; Database Management System Structure, Database Manager, Database Administrator, Data Dictionary; Brief Introduction to Distributed Databases and Client / Server Architecture

Module 4: The Relational Approach to DBMS (12 Hrs)
The Concept of relations in Mathematics, Mathematical concepts of sets, relations and functions, Relational approach to DBMS – Attributes and Domains; concept and properties of tables, cardinality and degree of relations, keys and different types of keys; strong entities and weak entities. Entity integrity rule, the foreign key and the rule of referential integrity. Normalization and Normal Forms: Normalizing databases with examples. Representation of relational database schemas, integrity constraints and different types; Relational Algebra. Operators in Relational Algebra.

Module 5: The Structured Query Language (SQL) (14 Hrs)
The need for SQL. Brief Introduction to query language and its evolution. Basic structure of SQL queries, Data Definition Commands: Data Types in SQL, CREATE, ALTER, DROP commands, Adding constraints in SQL, Basic operations in Data Manipulation using SQL, INSERT, SELECT,

DELETE, UPDATE, Substring comparison using LIKE operator, BETWEEN operator, SQL set operations UNION, EXCEPT, INTERSECT. Order By and Group By clauses, complex queries in SQL, Nested queries, EXISTS and UNIQUE functions, Renaming of attributes and joining of tables, Aggregate functions, Creating and Managing Views.

Book of Study:

1. Raghu Ramakrishnan & Johannes Gehrke, Database Management Systems, McGraw Hill International Edition

References:

1. Fundamentals of Database Systems 7th Edition, Elmasri & Navathe, Pearson Education
2. An introduction to database systems, C. J Date, 8th edition, Pearson education
3. Abraham Silberschatz, Henry F Korth & S Sudharssan, Database System Concepts, 4th edition, Tata McGraw Hill.

Course Title : Software Lab I (Core Practical)
Course Code : ICSC1CP6
Credits : 4
Total Hours : 108

The candidate needs to submit a Lab Record, duly signed by the teacher in charge and Head of the Department, (minimum of 20 programs, (10 + 10, C and SQL), failing to which he / she will not be allowed to attend the external software lab examination. The Lab record should be hard binded with name of the college and the emblem of the college depicted on the first page and should be properly indexed.

Syllabus for C Programs (54 Hrs)

1. Simple programs to familiarize printf() and scanf() functions.
2. Programs based on decision making statements, break, goto, continue, switch.
3. Programs using Loop controls statements.
4. Programs based on one dimensional and two-dimensional arrays (linear search, sort, matrix addition, multiplication, transpose etc.)
5. Programs on strings and string handling functions
6. Programs using the concept of pointers, operations on pointers, pointers to one dimensional array
7. Programs using the concept of functions, call by value, call by reference, recursion.
8. Programs based on structure and union, array of structures, pointer to structure, structure as argument to functions.
9. Simple programs using pointers and malloc().

Syllabus for SQL Programs (54 Hrs)

Problems involving the following topics to be included

1. Data definition commands – CREATE, ALTER, DROP, Adding Constraints, Primary Key, Foreign Key, Unique Key, check, not null.
2. Basic SQL queries INSERT, SELECT, DELETE, UPDATE, Using multiple tables, ordering of rows using ORDER BY option, Set operations using UNION, EXCEPT, INTERSECT, Substring comparison using LIKE operator, BETWEEN operator.
3. Complex Queries: Netsed Queries, EXISTS and UNIQUE / DISTINCT functions, NULL values, Renaming of attributes and Joining of tables Aggregate functions and grouping.
4. Managing views, Simple stored procedures

Semester II

Sl. No.	Course Code	Title	Hrs./ Week	Credits	Total hours
1	IML/IHN 2CC01	Second Language (T)	5	4	90
2	ICSC2CR2	Object Oriented Programming Using C++ (T)	3	3	54
3	ICSC2CR3	Data Structures using C++ (T)	3	3	54
4	ICSC2CR4	Operating Systems (T)	4	4	72
5	ICSC2CM5	Linear Algebra (T)	4	4	72
6	ICSC2CP6	Software Lab II (L)	6	4	108
		Total	25	22	450

Course Title : Second Language (Common Course)
Course Code : IML / IHN2CC01
Credits : 4
Total Hours : 90

As approved by the respective BoS (UG)

Course Title : Linear Algebra (Complementary)
Course Code : ICSC2CM5
Credits : 4
Total Hours : 72

As approved by the respective BoS (UG)

Course Objectives

- Able to develop a better intuition for machine learning and deep learning algorithms
- Able to choose proper hyperparameters and develop a better model

Module I: Introduction To Vector Spaces (15 Hrs)

Vector Spaces: Rn and Cn, lists, Fnand digression on Fields, Definition of Vector spaces, Subspaces, sums of Subspaces, Direct Sums, Span and Linear Independence, bases, dimension.

Module II: Linear Maps (20 Hrs)

Definition of Linear Maps - Algebraic Operations on - Null spaces and Injectivity - Range and Surjectivity - Fundamental Theorems of Linear Maps - Representing a Linear Map by a Matrix -

Invertible Linear Maps - Isomorphic Vector spaces - Linear Map as Matrix Multiplication - Operators - Products of Vector Spaces - Product of Direct Sum - Quotients of Vector spaces.

Module III: Eigenvalues, Eigenvectors and Eigenspaces (20 Hrs)

Eigenvalues and Eigenvectors - Eigenvectors and Upper Triangular matrices - Eigenspaces and Diagonal Matrices.

Module IV: Inner Products and Norms (17 Hrs)

Inner Products, Norms, Orthonormal Bases, Self-Adjoint and Normal Operators, Spectal theorem, Polar Decomposition and Singular Value Decomposition. (proof of all theorems are excluded for module 4)

Book of Study :

1. Sheldon Axler, Linear Algebra Done Right, Third Edition Springer, 2017.

Course Title : Object Oriented Programming using C++ (Core)
Course Code : ICSC2CR2
Credits : 3
Total Hours : 54

Course Objectives

On completion of the course, the student will be able to understand:

- Object oriented programming concepts and introduction of C++ Programming language.
- Different control structures used in C++ and implementation of functions in C++.
- Importance of class and objects concept in programming
- Role of constructors and destructors and importance of Operator overloading
- Different types of inheritance and implementation of polymorphism.

Module 1: Principles of Object-Oriented Programming, Beginning with C++ (10 Hrs)
Object Oriented Technology, Disadvantages of conventional programming, Programming Paradigms, Key concepts of Object oriented programming, Advantages of OOPs, Parts of C++ program, Types of tokens, Data types in C++, Type modifiers, Type casting, Constants, Constant pointers, Operators in C++, Referencing and dereferencing operators, Scope access operator, Memory management operators.

Module 2: Control structures and functions in C++ (12 Hrs)

Decision making statements, Loops in C++, Functions in C++, The main function, Parts of a function, Passing arguments, Return by reference, Default arguments, Inline function, Function overloading, Principles of function overloading.

Module 3: Classes and Objects (10 Hrs)
Structures in C++, Class in C++, Declaring Objects, public private protected keywords, Defining member functions, Characteristics of member functions, Outside member function inline, Rules for inline functions, Data hiding, Memory allocation for objects, Static member variables and functions, Arrays of objects, Objects as function arguments, Friend functions, Friend functions, Friend classes, Local classes

Module 4: Constructors, Destructors and Operator Overloading (10 Hrs)
Constructors and destructors, Characteristics of constructors and destructors, Applications with constructors, Constructors with arguments, Overloading Constructors, Constructors with default arguments, Copy constructors, Destructors, Operator overloading, Overloading of unary operators, Overloading binary operators, Overloading with friend functions, Type conversion, Rules for overloading operators.

Module 5: Inheritance, Pointers, Binding, Polymorphism and Virtual functions (12 Hrs)
Inheritance, Access specifiers and simple inheritance, Types of inheritance, Virtual base classes, Constructors, Destructors and Inheritance. Pointer, Pointer declaration, void pointers, wild pointers, Pointers to objects, this pointer, pointers to derived classes and base classes, Binding in C++, Pointers to derived class objects, Virtual functions, Rules for virtual functions, Pure virtual functions, Abstract classes, Working of virtual functions, Object slicing

Book of Study:

1. Ashok N. Kamthane Object Oriented Programming with ANSI & Turbo C++, First Edition, Pearson India.

References:

1. E. Balagurusamy – Object Oriented Programming with C++, Fifth edition, Tata McGraw Education Hill, 2011.
2. Ravichandran – Object Oriented Programming in C++, TMH, 3rd Edition

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Course Title : Data Structures using C++ (Core)
Course Code : ICSC2CR3
Credits : 3
Total Hours : 54

Course Objectives

Upon successful completion of this course, students should be able to:

- Describe fundamental concepts of data structures.
- Illustrate the representation of arrays in memory and operations on it
- Compare and Contrast different searching and sorting techniques.
- Design operations on linear data structures such as stacks and queues.
- Implement operations on various types of linked lists

Module 1: Introduction to Data structures (10 Hours)

Introduction to Data Structures, Definition, Classification of Data Structures, Primitive and Non primitive, Operations on data structures, Static and dynamic memory allocation. Dynamic memory allocation and pointers, Memory allocation operators in C++. User defined data types in C++. Recursion, Recursive functions in C++.

Module 2: Array (10 Hours)

Arrays, Linear array – Representation of array in memory, operations on linear array – Insertion, Deletion, Sorting and Searching. Two Dimensional Arrays – Representation of 2D array in memory, operations on 2D array, Multidimensional Arrays.

Module 3: Search and Sort (10 Hours)

Search, Basic search techniques, Search algorithms, Searching techniques, Sequential search, Binary search. Sort, general background, definition, different types, Bubble Sort, Selection Sort, Merge Sort.

Module 4: Stack and Queue (12 Hours)

Stack, Definition, Array representation of stack, Operations on stack. Infix, prefix and postfix notations, Conversion of an arithmetic expression from infix to postfix, Postfix evaluation, Applications of stack. Queue – Definition, Array representation of queue, Simple queue operations. Circular queues, Double ended queue, Priority queue.

Module 5: Linked List (12 Hours)

Linked list – definition, Components of linked list, Representation of linked list, Advantages and disadvantages of linked lists, Types of linked list. Singly linked list, Operations on singly linked list, Creation, Insertion, Deletion, Search and display. Circular linked list, Operations on circular linked list, Creation, Insertion, Deletion, Search and Display.

Book of Study:

1. G.S Baluja, Data Structures Through C++ (A Practical Approach), Danapat Rai & Co.

References:

1. Ellis Horowitz and Sartaj Sajni, Fundamentals of Data Structures, Galgotia publications
2. Seymour Lipschutz, Theory and Problems of Data Structures, Schaums Outline Series

Course Title : Operating System (Core)
Course Code : ICSC2CR4
Credits : 4
Total Hours : 72

Course Objectives:

After completing the course, the student should be able to explain

- The fundamental concepts regarding an OS
- Concept of a process and management of processes
- Inter process synchronization methods and deadlock handling
- Various memory management techniques
- Concept of file and various file handling methods

Module 1: Introduction (14 Hrs)

OS Definition, Functions, Types of operating systems – Batch Operating System, Multi programming, Time sharing, Real time, distributed operating systems – Operating System Operations, Operating System Services, User Operating System Interface, System Calls, Types of System Calls.

Module 2: Processor Management (14 Hrs)

Job and process concept, Operating system view of process, process state, state transition diagram, PCB (Process control block), System state and process lists, process switch, threads, multi-threading operating system, operating system services for process management. Process Scheduling – Types of schedulers, scheduling and performance criteria, scheduling algorithms, multiple processor scheduling.

Module 3: Inter process synchronization and communication (16 Hrs)

Concurrent Processes, need for inter process synchronization, critical section problem, mutual exclusion, mutual exclusion algorithms, semaphore definition, primitives, implementation of semaphores, monitors

Deadlocks – Definition, Deadlock characterization, Resource allocation graph, methods for handling deadlocks, deadlock prevention, deadlock avoidance, safe state, resource allocation graph algorithm, Banker's algorithm, deadlock detection, recovery from deadlock.

Module 4: Memory Management (16 Hrs)

Preliminaries, address binding, dynamic linking and loading, Overlays. Logical versus physical address space, Swapping, Contiguous allocation – fragmentation, compaction, Paging – principles of page allocation, structure of page table, hardware support, multi level paging, Segmentation – principles of operation, hardware, implementation of segment table, protection and sharing, fragmentation, segmentation with paging. Virtual Memory – Demand paging, Page replacement algorithms, page allocation policies – Thrashing, hierarchical address translation tables, MMUS

Module 5: File Management (12 Hrs)

File Structure, File types, File access, File attributes, File operations, Directories – Flat directory systems, hierarchical directory systems. File system implementation – Allocation methods, contiguous allocation, linked allocation, indexed allocation.

Book of Study:

1. Siberschatz, Galvin, Gagne: Operating System Concepts, 7th Edition

References:

1. Andrew S. Tanenbaum, Modern Operating Systems, Prentice Hall India
2. Dhamdhere, System software and operating systems – Tata Mc Graw Hill
3. H M Deitel, An introduction to Operating System – Adison Wesley
4. Tanenbaum, Modern Operating Systems – Prentice Hall
5. William Stallings, Operating Systems – Pearson Education

Course Title : Software Lab II (Core Practical)
Course Code : ICSC2CP6
Credits : 4
Total Hours : 106

The candidate needs to submit a Lab Record, duly signed by the teacher in charge and Head of the Department, (minimum of 20 Programs, (10 + 10, CPP and DS) failing to which he / she will not be allowed to attend the external software lab examination. The lab record should be hard binded with the name of college and the emblem of the college depicted on the first page and should be properly indexed.

Syllabus for CPP programs (minimum of 10 questions) [54 Hrs]

1. Programs based on array of objects, friend functions, passing objects as arguments to function.
2. Programs based on array of objects, friend functions, passing objects as arguments to function.
3. Programs based on operator overloading (binary, unary) using member functions and friend functions
4. Programs based on constructors, different types of constructors.
5. Programs based on inheritance, different types of inheritance, polymorphism

Syllabus for Data Structures using CPP (minimum of 10 questions) [54 Hrs]

Student needs to code and implement CPP programs for the following:

Arrays – Insertion, Deletion, Polynomial addition using arrays

Sort – Selection, Insertion, Quick

Search – Linear search, Binary search

Sparse matrix –

Sparse form representation, transpose and addition using the sparse form

Stack –

Implementation using arrays (linear stack), Infix to postfix conversion, Postfix evaluation

Queue –

Implementation using arrays (linear queue), Implementation of circular queue

Singly linked list – Implementation using dynamic memory allocation techniques, arrange the list based on the ascending or descending order of the information field, concatenate two linked lists, interchange any two nodes in a list, Implementation of circular list, Implementation of linked stacks and queues.

Doubly linked list – Implementation of doubly linked list, Implementation of circular doubly linked list.

Semester III

Sl. No.	Course Code	Title	Hrs./ Week	Credits	Total Hours
1	ICSD3CR1	Introduction to Data Science (T)	4	4	72
2	ICSC3CR2	Programming in Python (T)	3	3	54
3	ICSC3CR3	R Programming and Mathematics for Artificial Intelligence (T)	4	3	72
4	ICSC3CR4	Computer Organization and Architecture (T)	4	4	72
5	ICSA3CM5	Probability and Statistics (T)	4	4	72
6	ICSD3CP6	Software Lab III: Python and R Programming (L)	6	2	108
		Total	25	20	450

Course Title : Introduction to Data Science (Core)
Course Code : ICSD3CR1
Credits : 4
Total Hours : 72

Course Objectives

- To develop fundamental knowledge of concepts underlying data science and give a hands-on experience with real-world Problems.
- Know standard methods of data analysis and information retrieval.
- Able to formulate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods.

Module 1: Introduction: Data Science (14 Hrs)
Introduction: Data Science - Evolution of Data Science - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed, Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model.

Module 2: Data Analysis and Basic Tools (16 Hrs)
Data Analysis and Basic Tools: Exploratory Data Analysis and the Data Science Process -Basic tools of Exploratory Data Analysis - Philosophy of Exploratory Data Analysis - The Data Science Process - Case Study, Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means - Feature Generation and Feature Selection.

Module 3: Feature Extraction (14 Hrs)
Feature Extraction: Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

Module 4: Recommendation Systems (14 Hrs)
Recommendation Systems: Nearest Neighbor Algorithm - Algorithmic ingredients of a Recommendation Engine. Case Study.

Module 5: Dimensionality Reduction (14 Hrs)
Dimensionality Reduction: Singular Value Decomposition - Principal Component Analysis. Data Visualization and Fraud Detection.

References:

1. Cathy O'Neil and Rachel Schutt. "Doing Data Science, Straight Talk from the Frontline". O'Reilly Edition, 2014.
2. V.Bhuvaneswari, T. Devi, "Big Data Analytics: A Practitioner's Approach", Sci-TechPublications, 2016.
3. Jure Leskovek, Anand Rajaraman and Jerey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)

Course Title : Programming in Python (Core)
Course Code : ICSC3CR2
Credits : 3
Total Hours : 54

Course objectives

After completing this course, the student will

- understand basic knowledge in Python programming.
- learn how to design and program Python applications.
- acquire object-oriented skills in Python.
- able to work with python standard library.

Module 1: Programming Environment and Python Basics (10 Hrs)
Programming Environment and Python Basics: Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. Basic coding skills – Writing simple programs.

Module 2: Building Python Programs (10 Hrs)
Building Python Programs: Data types, variables, operators. Control statements – branching controls, simple if, if - else, if - elif -else; looping, while, for. Functions - defining, calling, returning values, functions with default arguments, recursive functions, nested functions and lamda functions. Strings - operation, string functions. Work with dates and times.

Module 3: Containers (10 Hrs)

Containers: Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples and Sets. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup.

Module 4: Object Oriented Programming (12 Hrs)

Object Oriented Programming: Design with classes, Inheritance – multi-level and multiple inheritance. Exceptions - Handle a single exception, handle multiple exceptions. Introduction to file I/O - Reading and writing text files, Manipulating binary files. More concepts: Decorators, generators and iterators.

Module 5: Scientific Python (12 Hrs)

Scientific Python: NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Random Numbers. Plotting and visualization. Matplotlib - Basic plot, Ticks, Labels, and Legends. Pandas: operations on CSV files. Reading, Manipulating, and Processing Data. Python GUIs and event handling using tkinter.

Book of Study:

1. Kenneth A Lambert., Fundamentals of Python: First Programs, 2/e, Cengage Publishing,2016
2. Jeeva Jose, P Sojan Lal, Introduction to Computing and Problem solving with Python, Khanna Book Publishing, 2016
3. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
2. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
3. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.

Course Title : R Programming and Mathematics for Artificial Intelligence (Core)
Course Code : ICSC3CR3
Credits : 3
Total Hours : 72

Course Outcome

- On completion first two units of the course, students will be able to use R language for programming purposes
- The remaining three units will enable the student to become confident in the mathematical portions needed in the field of artificial intelligence.

- The lab sessions for the paper is so designed to make the student an expert in R to solve problems in mathematics.

Module 1: (12 Hrs)

R Programming -Fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments, arguments, scope, logic and statements in R, logical equivalence, Sets with R: Cardinality, Equality, Empty set, Subset, Union, Intersection, Complement, Cross product and Algebraic properties.

Module 2: (14 Hrs)

R Programming - Exploring and cleaning data for analysis, Data organization, Arrays, and Matrices, Basics of Arrays in R, Matrix operations, Advanced Matrix operations, Additional Matrix facilities, Lists and Data frames. Mapping models to Machine Learning, Evaluating and Validating models, Probability distributions in R, Statistical models in R, Building, linear models, Generalized linear models, Nonlinear least squares and maximum likelihood models.

Module 3: (15 Hrs)

Sets, Operations on sets, Venn Diagrams, Multi Sets, Binary Relations, Equivalence Relations, Ordering Relations, Operations on Relations, Partial Orders. Statements and Notation, Connectives, Quantified Propositions, Logical Inferences, Methods of Proof of an Implication, First Order Logic and other Methods of Proof, Rules of Inference for Quantified Propositions, Proof by Mathematical Induction.

Module 4: (15 Hrs)

Linear Algebra – System of Linear equations, Solving System of Linear equations, Linear Independence, Vectors, Scalars, Addition, Scalar multiplication, dot product, vector projection, cosine similarity. Support Vector Machines, Implementation using Python, Classification using Support Vector Machines.

Module 5: (16 Hrs)

Matrices, determinants, inverse of matrix. System of equations, Linear transformation - rank and nullity, Consistency, and Inconsistency of linear system of equations, rank nullity theorem, Echelon form of a matrix and Row reduced echelon form of matrix. Correlation coefficient, Eigen values and Eigen vectors. Principle Component analysis (PCA) – Concepts and properties. Dimensionality reduction with PCA.

Book of Study

1. N Matloaff ,“The art of R Programming”, No Starch Press, Inc, 2011, Ist edition,ISBN-10: 1-59327-384-3, ISBN-13: 978-1-59327-384-2.
2. William B. Claster, “Mathematics and Programming for Machine Learning with R: From the Ground Up” CRC Press; 1st edition (27 October 2020), ISBN: 9780367507855.
3. For Maths

4. Kenneth H. Rosen, “Discrete Mathematics And Its Applications”, 7th Ed,McGrawHill, 2012.
5. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India, 9th Edition 2011.

References

1. Nina Zumel, John Mount, Jeremy Howard, Rachel Thomas, “Practical Data Science With R”, Manning Publications, Year: 2020, ISBN: 1617295876, 9781617295874.
2. “Mathematics for Data Science and Machine Learning using R” by Eduonix, September 2019, Packt Publishing, ISBN: 9781839210945.
3. Mark Gardener, “Beginning R: The Statistical Programming Language”, ISBN: 978-1-118-16430-3 May 2012.

Web References

1. https://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf

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Course Title : Computer Organization and Architecture (Core)
Course Code : ICSC3CR4
Credits : 4
Total Hours : 72

Course objective

Upon successful completion of this course, students should be able to:

- Describe the fundamental organization of a computer system
- Explain addressing modes, instruction formats and program control statements
- Analyze the organization and performance of system memory hierarchy
- Describe basic concept of parallel computing.
- Describe fundamentals concepts of pipeline and vector processing

Module 1: (16 Hrs)

Introduction: Functional units of a computer, Basic operational concepts, Number System – Conversion of one number system to another, 1’s complement, 2’s complement, Gray code, binary arithmetic, Logic gates – AND, OR, NOT, XOR, Universal Gates – Simplification using universal gates alone. Truth Table, Boolean algebra- simplification, laws. Simplification using k-map (SOP and POS). Bus structure, Memory locations and addresses, Instructions and instruction sequencing, Instruction execution. Instruction Formats, Addressing Modes.

Module 2: (14 Hrs)

Central Processing Unit: General Register Organization, Stack Organization, Instruction Formats, Instruction Classification, Addressing modes. (14 Hrs.)

Module 3: (12 Hrs)
Memory: Memory Hierarchy, RAM, ROM, Cache Memories, Virtual memory.

Module 4: (16 Hrs)
Pipeline and Vector Processing: Parallel Processing, Architectural classification scheme-SISD, SIMD, MISD, MIMD, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor.

Module 5: (14 Hrs)
Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence.

Book of Study

1. Computer Organization, V. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5th Edition, McGraw Hill Education.
2. Computer System Architecture, M. Morris Mano, Third Edition, Pearson/PHI.

References

1. Computer Organization and Architecture – William Stallings, Sixth Edition, Pearson/PHI.
2. Computer Architecture and Parallel Processing, Kai Hwang and F. A. Briggs, McGraw Hills
3. Computer Architecture & Organization– John P Hayes, Mc Graw Hill.
4. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, Pearson/PHI.

Course Title : Probability and Statistics (Complementary)
Course Code : ICSD3CM5
Credits : 4
Total Hours : 72

Course Objectives

- Acquire the mathematical foundations of probability and statistics for data science activities.
- Learn probability with underlying motivation being statistics for data science .
- Learn hands-on on generating random numbers and programming for statistics.

Module 1: (21 Hrs)
Introduction to Statistics, concepts of a statistical population and sample, Data types- qualitative and quantitative, discrete and continuous, primary and secondary. Different types of scale- nominal and ordinal, ratio and interval.

Data Collection and sampling techniques- SRS, systematic, stratified and cluster schedule and questionnaire. Data collection: direct, using third parties, sending questionnaire, by mail/telephone,
Classification and tabulation - One-way and two-way classified data, Preparation of frequency distribution, relative frequency and cumulative frequency distributions.

Graphs: Stem-and-leaf chart, Pie Char, Bar Chart, Histogram, Frequency polygon, Frequency curve and Ogives.

Module 2: (17 Hrs)
Descriptive Measures: Averages- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted averages. Quantiles- quartiles, deciles, percentiles.
Measure of Dispersion: Absolute and relative measures dispersion - Range, Quartile Deviation, Mean Deviation and Standard Deviation, Co-efficient of variation, Box plot.
Moments: Raw moments, central moments and their inter relation, skewness- Pearson's, Bowley's and moment
Measures of skewness and Kurtosis- percentile and moment measure of kurtosis.

Module 3: (17 Hrs)
Probability Random Experiments-Algebra of events- Mutually exclusive, equally likely and independent events. Classical, Frequency and Axiomatic approaches to probability. Monotone property, Addition theorem, Boole's inequality (finite case), and other simple properties.
Conditional probability. Multiplication theorem (up to 3 events). Independence of events. Total probability law. Bayes' theorem.
Random variables- discrete and continuous random variables. Probability mass and density functions, and distribution functions. Evaluation of conditional and unconditional probabilities. Change of variables- methods of Jacobian and distribution function (one variable case).
Bivariate Random Variables: bivariate probability mass and density functions. Marginal and conditional distributions. Independence of bivariate random variables.
Mathematical Expectation: Expectation of random variables and their functions. Definition of - Raw moments, central moments and their inter-relation, covariance.

Module 4: (17 Hrs)
Correlation and Regression: Measure of association between two variables. Types of correlation, Scatter diagram, Karl Pearson's Coefficient of correlation and its mathematical properties, Spearman's Rank correlation and its interpretations, Regression Analysis, linear regression equations, properties of regression coefficients, Multiple regression model.

Book of Study

1. S C Gupta and V K Kapoor; Fundamentals of Mathematical Statistics; Sultan Chand and Sons New Delhi

References

1. 1.S P Gupta; Statistical Methods; Sultan Chand and Sons New Delhi
2. M R Spiegel; Theory and Problems of Statistics Schaum's Outline Series

Course Title : Software Lab III: Python and R Programming (Core Practical)
Course Code : ICSD3CP6
Credits : 2
Total Hours : 108

I. Programming in Python- Lab (54 Hrs)

1. Programs using conditional Branching and looping
2. Programs using functions and strings
3. Programs using Lists, Dictionaries, tuples and sets.
4. Program for traversing dictionaries
5. Programs using class, Inheritance and Exceptions.
6. Programs using files.
7. Arrays and Matrix using NumPy.
8. Plotting and Visualization using Matplotlib (Line, bar chart, pie chart etc..).
9. Data manipulations (data series and data frames) using Pandas
10. Simple programs using GUI

II. Programming using R language- Lab. (54 Hrs.)

1. R Program to add two vectors. The program covers:
   a. R Vector
   b. R Operators
2. Find sum, mean and product of vector in r using built-in functions. The program covers:
   a. R Variables and Constants
   b. R Functions
3. R program to print the Fibonacci sequence by taking input from the user. The program covers:
   a. R if…else Statement
   b. R while loop
4. R program to find the factors of a number. The program covers:
   a. R Functions
   b. R for Loop
5. Calculator Application in R. The program covers:
   a. Using with and without R objects on console
   b. Using mathematical functions on console
6. Reading and writing different types of datasets

a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.

b. reading Excel data sheet in R.

c. reading XML dataset in R

7. Solve this system using R:
   Compute the inverse of the resultant matrix, Compute the determinant matrix, Compute the Eigenvalues/eigenvector. $x1 + x2 = 2$ $-x1 + x2 = 4$
8. Solve the system of linear equations using R.
   $5x + y = 15$, $10x + 3y = 9$
9. Write an R program to access the element at 3rd column and 2nd row, only the 3rd row and only the 4th column of a given matrix.
10. Descriptive statistics in R
    a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars & cars datasets.

    b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.

Semester IV

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	IEN4CC01	English II (T)	5	4	90
2	ICSD4CM2	Probability Distributions and Statistical Inference (T)	4	3	72
3	ICSC4CR3	Data Mining (T)	4	4	72
4	ICSC4CR4	Software Engineering (T)	4	3	72
5	ICSC4CR5	Basics of Artificial Intelligence (T)	4	3	72
6	ICSD4CMP6	Complementary Lab: Statistical Analysis using R (L)	2	2	36
7	ICSD4CP7	Software lab IV (L)	2	1	36
		Total	25	20	450

Course Title : English II – English Language Skills for Academic Purposes(Common)
Course Code : IEN4CC01
Credits : 4
Total Hours : 90

As Approved by Board of Studies of English.

Course Objective:

This course seeks to develop the basic language skills of the students. The course attempts to give the students training in writing and speaking skills.

Module 1: Vocabulary and Grammar Section (36 Hrs)
Word Formation
Tenses
Concord
The passive Voice

Module 2: Writing Skills (36 Hrs)
Paragraph Writing
Email
Picture Description
Story Writing

Module 3: Speaking Skills (18 Hrs)

Day to Day Conversatios
Oral Presentation Skills
Narrating a story

Core Text:

English Language Skills for Academic Purposes: A Text Book for College Students

Course Title : Probability Distributions and Statistical Inference (Complementary)
Course Code : IEN4CC01
Credits : 4
Total Hours : 90

Module 1: (17 Hrs)

Discrete Distributions: Degenerate, Uniform, Bernoulli, Binomial, Hyper geometric, Negative binomial, Geometric, Poisson

Mean, variance, m.g.f, their properties-fitting of Binomial and Poisson, memory less property of Geometric distribution, multinomial distributions and its applications.

Module 2: (19 Hrs)

Continuous Distributions: Uniform, Exponential, Gamma, Cauchy, Pareto, and Laplace - mean, variance, m.g.f, characteristic function, their properties - memory less property of exponential distribution.

Normal and Lognormal Distributions: Properties, fitting of normal distribution, linear combination of normal variates, use of standard normal tables for various probability computation. Bivariate normal-marginal and conditional distributions.

Sampling Distributions: Concept of sampling distributions, Statistic(s) and standard error(s). Mean and variance of sample mean when sampling is from a finite population. Sampling distribution of mean and variance from normal distribution. Chi-square, t, F distributions and statistics following these distributions. Relation among Normal, Chi- square, t and F distributions.

Module 3: (17 Hrs)

Point Estimation: Concepts of Estimation, Estimators and Estimates. Point and interval estimation. Properties of good estimators- unbiasedness, efficiency, consistency and sufficiency.

Confidence Intervals: 100(1-α) % confidence intervals for mean, variance, proportion, difference of means and proportions and variances.

Module 4: (19 Hrs)

Testing of Hypotheses: Statistical hypotheses, null and alternate hypotheses, simple and composite hypotheses, type-I and type-II errors. Critical Region. Size and power of a test, p- value, large sample tests - Z-tests for means, difference of means, proportion and difference of proportion, chi-square tests for independence, homogeneity and goodness of fit. Normal tests for mean, difference of means and proportion (when σ known), t-tests for mean and difference of means (when σ

unknown), t-test for r = 0, paired t-test, test for proportion (binomial), chi-square test, F-test for ratio of variances. ANOVA
Non-Parametric Tests: Introduction to Non parametric tests, non-parametric equivalent of parametric tests.

Book of Study

1. Rohatgi V.K. An Introduction Probability Theory and Mathematical Statistics, John Wiley and sons

References

1. Gupta S. C. and Kapoor V. K. (2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.
2. George Casella, Roger L. Berger. Statistical Inference (2nd Ed).
3. Goon A. M., Gupta M. K., and Dasgupta B. (2005). Fundamentals of Statistics, Vol. I, 8th edition, World Press, Kolkatta.
4. Gibbons J.K (1971). Non-Parametric Statistical Inference, McGraw Hill.

Course Title : Data Mining (Core)
Course Code : ICSC4CR3
Credits : 4
Total Hours : 72

Course Objectives

- To identify the scope and essentiality of Mining
- To analyze data, choose relevant models and algorithms for respective applications. To develop research interest towards advances in data mining.
- To introduce the basic concepts and techniques of Data mining

Module 1: Introduction (12 Hrs)
Introduction: What is Data mining? Data Mining Tasks, KDD process, Major issues in Data Mining, Data objects and Attribute types- Nominal, Binary, Ordinal and Numeric attributes, Measuring the central tendency- Mean, Median and Mode. Data Warehouse.

Module 2: Data Pre-processing (14 Hrs)
Data Pre-processing: Needs of Pre-processing the Data, Data Cleaning- Missing Values, Noisy Data, Data Cleaning as a Process. Data Integration- Redundancy and correlation analysis, Data Reduction- Attribute Subset Selection, Dimensionality Reduction, Numerosity Reduction, PCA. Data Transformation strategies, Data transformation by Normalization, Discretization by Binning, Histogram Analysis

Module 3: Association Analysis (14 Hrs)

Association Analysis - Frequent patterns, Basic terminology in association analysis- Binary representation, Itemset and support count, Association Rule, Support and Confidence, Frequent Item set generation- The Apriori Algorithm, Generating Association Rules from Frequent Itemsets, FP Growth algorithm, From Association Analysis to Correlation Analysis.

Module 4: Classification (16 Hrs)

Classification- Basic concepts, General approach to classification, Nearest neighbor models, Cross validation and re-sampling methods- kfold cross validation, Boot strapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART)

Module 5: Cluster Analysis (16 Hrs)

Cluster Analysis: Introduction, Basic Clustering methods- Partitioning methods- k-Means and k-Medoid. Hierarchical Methods - Agglomerative and Divisive Hierarchical Clustering. Density Based Methods - DBSCAN, OPTICS. Grid Based- STING, CLIQUE, Outlier Analysis- what are outliers, Types of outliers, Outlier detection methods - Statistical Distribution-based Outlier Detection, Distance-Based Outlier Detection. Mining other kinds of data – Mining spatial data, mining multimedia data, mining text data, mining web data.

Book of Study

1. Jiawei Han & Micheline Kamber, Data Mining, Concepts and Techniques, , 3rd Edition.
2. Pang Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson India Education Services.

References

1. Arun K Pujari, Data Mining Techniques, , University Press
2 Sam Anahory & Dennis Murray, Data Warehousing in the Real World, Pearson Education, Asia.
3. Paulraj Ponnaiah, Data Warehousing Fundamentals,Wiley Student Edition

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Course Title : Software Engineering (Core)
Course Code : ICSC4CR4
Credits : 4
Total Hours : 72

Course Objectives

Upon the completion of the course, students should be able to

- Recognize the importance of basic processes in software Development life cycle.
- Understand the various activities associated with different models and their significance.
- To provide better understanding about the basic concepts of Software Engineering
- Familiarize the requirements in engineering and systematic approach in classical softwaredesign and development techniques.
- Familiarize with various software testing techniques and tools.
- Perceive the importance of Software Maintenance

Module 1: **Introduction (14 Hrs)**

Introduction: Evolution, Types of software development products; Software life cycle models: A few basic concepts, Waterfall model and its extension, Agile development models, Spiral model, Comparison of different life cycle models

Module 2: **Software Project Management (14 Hrs)**

Software Project Management, Project Planning, Metrics for project size estimations, Project Estimation Techniques, Basic COCOMO model, Scheduling, Organization structure, Team structure, Staffing, Risk Management, Software Requirements Analysis and Specification: Requirements gathering and analysis, Software Requirements Specification (SRS)

Module 3: **Software Design (14 Hrs)**

Software Design: overview of the design process, how to characterize a good softwaredesign, Cohesion and Coupling, layered arrangements of modules, Approaches to software design, Function oriented design: Overview of SA/SD Methodology, Structured analysis, Developing the DFD model of a system, Structured Design, User Interface design: Characteristics of a good user interface, Basic concepts, Types of user interfaces

Module 4: **Coding and Testing (14 Hrs)**

Coding and Testing: Coding, Code review, Software documentation, Testing, Unit testing, Black box testing, white box testing: Basic concepts, Debugging Integration testing, system testing, Software Reliability and quality management: Software reliability, Software quality

Module 5: **Software maintenance (16 Hrs)**

Software maintenance: Characteristics of software maintenance, Software reverse engineering, Software process models, Estimation of maintenance cost, Software Reuse: Basic issues in any Reuse Program, A Reuse approach, Reuse at Organization level , Emerging Trends:Client Server Software, Client Server architectures, CORBA, Service Oriented Architecture (SOA), Software as a Service (SaaS).

Book of Study

1. Fundamentals of Software Engineering, Fifth Edition by Rajib Mall, PHI Learning Pvt. Ltd., February 2019.

References

1. Software Engineering 10th Edition by Ian Sommerville, PEARSON INDIA, October 2018.
2. Software Engineering – a Practitioner's approach Seventh Edition by Roger S Presman, 7th edition, McGraw Hill. 2017.

Course Title : Basics of Artificial Intelligence (Core)
Course Code : ICSC4CR5
Credits : 3
Total Hours : 72

Course Objectives

Upon successful completion of this course students should be able to:

- Explain the basics of AI.
- Identify appropriate AI methods to solve a given problem.
- Will be able understand the concept of differentiation and its applications
- Should have sound knowledge in the field of probability and correlation and regression

Module 1: (14 Hrs)

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

Module 2: (14 Hrs)

Knowledge representation, Knowledge representation using Propositional & Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge. Game playing.

Module 3: (15 Hrs)

Differentiation, Limits and continuity rules of differentiation, Derivatives, Scalar derivatives, Partial derivatives, Differentiation of univariate functions, Partial differentiation and gradients, Gradient of vector valued function. Gradient of matrices. Optimization using gradient functions, constrained optimization, and Lagrange multipliers. Convex optimization. Back propagation in neural networks, implementation and application.

Module 4: (15 Hrs)

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, The Method of Characteristic Roots, Solutions of Inhomogeneous Recurrence Relations, Complexity calculations of prominent algorithms.

Module 5: (14 Hrs)

Probability, basics, Conditional Probability, Bayes Theorem, Distributions - Binomial, Poisson, normal distributions, and related problems. Descriptive Statistics, Regression, and correlation, Bayesian classification, implementation, applications.

Books of Study

1. Artificial Intelligence, Deepak Khemani, Tata Mc Graw Hill Education.
2. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", 7th Ed, McGraw-Hill, 2012.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition 2011.
4. Walpole, R. E., Myers, R. H., Myers S L & Keying Ye, 'Probability and Statistics for Engineers and Scientists'. 8th ed, Pearson Education, 2007.

Course Title : Complementary Lab: Statistical Analysis using R (Complementary Lab)
Course Code : ICSD4CMP6
Credits : 2
Total Hours : 36

Programs based on the following concepts: (36 Hrs.)

Doing Math and Simulation in R, Math Function, Cumulative Sums and Products-Minima and Maxima- Calculus, Functions for Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files,

Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests, ANOVA.

Linear Models, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression.

Course Title : Software Lab IV (Core Practical)
Course Code : ICSD4CP7
Credits : 1
Total Hours : 36

Software Lab IV- Data Mining Implementation using Python / R (36 Hrs.)

Implement at least 15 programs / models in Python / R. The programs may include:

1. Implement Apriori algorithm for frequent item set generation using Python.
2. Implementation of Classification in Python using
   a. KNN
   b. Decision Tree

3. Implementation of Clustering in Python using
   a. K-means
   b. K-medoid
4. Regression Model using R/Python
   a. Import a data from web page
   b. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institution based on his/her GRE score, GPA obtained and rank of the student.
   c. Also check whether the model if fit or not.
5. Classification model using above dataset:
   a. Install relevant package for classification
   b. Choose classifier for classification problem
   c. Evaluate the performance of classifier
6. Implementation of Correlation and Covariance analysis using R/Python
   a. Find the correlation matrix
   b. Plot the correlation plot on dataset and visualize an overview of relationships among data on iris dataset.
   c. Analysis of covariance: Variance (ANOVA), if data have categorical variables on iris data.

Semester V

Si. No.	Course Code	Title	Hrs./ Week	Credits	Total Hours
1	ICSC5CR1	Principles of Machine learning (T)	3	4	54
2	ICSC5CR2	Web application Development Using PHP (T)	4	3	72
3	ICSC5CR3	Programming in Java (T)	4	3	72
4	ICSC5CR4	IT and Environment (T)	3	4	54
5	ICSD5PR5	Project Minor - Phase I (L)	3	-	54
6	ICSD5CP6	Software Lab V: Java and PHP (L)	8	3	144
		Total	25	17	450

Course Title : Principles of Machine Learning (Core)
Course Code : ICSC5CR1
Credits : 4
Total Hours : 54

Course Objectives

On completion of the course, the student should have:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To understand the supervised learning techniques such as Linear Regression, Logistic Regression, Support Vector Machine, Naïve Bayes Classifier.
- To understand the biological neural network and to model equivalent neuron models.

Module 1: (12 Hrs)

Introduction to Machine Learning – Machine learning basics, Types of machine learning, Applications of Machine Learning, Basic types of data in Machine learning, Data pre-processing, Predictive Vs Descriptive models, training a model, training versus testing, cross validation, overfitting & underfitting, Bias variance tradeoff, error measures, evaluating performance of a model. Introduction to feature engineering, ML tools in Python.

Module 2: (10 Hrs)

Linear Regression – Problem formulation, Parameter Estimation, Bayesian Linear Regression, Multiple linear regression, fitting simple linear and multiple linear regression equations with examples, regularization techniques, case study and implementation.

Module 3: (10 Hrs)

Logistic Regression - Interpreting Parameters in Logistic Regression, Inference for Logistic Regression, Logistic Models with Categorical Predictors, Multiple Logistic Regression, Fitting Logistic Regression Models and its implementation using real life examples.

Module 4: (10 Hrs)

Support Vector Machine (SVM) Algorithm, Types of SVM, Hyperplane and Support Vectors, Working of SVM Applications of SVM; Naïve Bayes Classifier Algorithm, Bayes' Theorem, Types of Naïve Bayes Model, Working of Naïve Bayes' Classifier, Applications of Naïve Bayes Classifier

Module 5: (12 Hrs)

Artificial Neural Network (ANN): Features, structure and working of Biological Neural Network (BNN), Comparison of BNN and ANN, History of neural network research, characteristics of neural networks, terminology, Applications of ANN, models of neuron McCulloch-Pitts model, Perceptron, Basic learning laws, Topology of neural network architecture. Backpropagation networks (BPN), Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input-hidden and output layer computation, backpropagation algorithm, selection of tuning, parameters in BPN, learning.

Books of Study

1. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Person, 2020.
2. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", 2020.
3. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow" Powered by Jupyter, published by O'Reilly Media.
4. Artificial neural network, B. Yegnanarayana - PHI Publication.
5. Neural networks, Fuzzy logic and Genetic Algorithms; S. Raj Sekaran and Vijayalakshmi Pari

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Course Title : Web Application Development using PHP (Core)
Course Code : ICSC5CR2
Credits : 3
Total Hours : 72

Course Objectives

Upon successful completion of this course, students should be able to:

- Develop web applications using PHP and MySQL database.
- Use java scripts and jQuery in client side
- Use CSS concepts in Webpage designing

Module 1: (16 Hrs)

Introduction to PHP- Structure of PHP-Comments, Basic Syntax, Variables, Variable Assignment, Variable Typing, Constants, Predefined Constants, echo vs print Command, Functions, Variable Scope.

Expressions and Control Flow in PHP- Expressions, Conditionals- if Statement, else Statement, elseif Statement, switch Statement? Operator, Looping- while Loops, do...while Loops, for Loops, break, continue Statement.

PHP Functions and Objects- PHP Functions- Defining a Function, Returning a Value, Returning an Array, Passing Arguments by Reference, Returning Global Variables, Including and Requiring Files, PHP Objects- Declaring a Class, Creating an Object, Accessing Objects, Cloning Objects, Constructors, Destructors, Writing Methods, Declaring Properties, Declaring Constants, Property and Method Scope, Static Methods, Static Properties, Inheritance.

Module 2: (14 Hrs)

PHP Arrays -Basic Access- Numerically Indexed Arrays, Associative Arrays, Assignment Using the array Keyword, foreach Loop, Multidimensional Arrays, Array Functions .Accessing MySQL Using PHP -Connecting to a MySQL Database, $_POST Array, create, insert, delete, update, select operations in MySQL database using PHP, Form Handling - Building Forms - Retrieving Submitted Data, Default Values, Input Types, HTML5 Enhancements- autocomplete Attribute, autofocus Attribute, placeholder Attribute, required Attribute, Override Attributes, width and height Attributes, min and max Attributes, step Attribute, form Attribute, list Attribute, color Input Type, number and range Input Types, Date and Time Pickers.

Module 3: (14 Hrs)

Exploring JavaScript - JavaScript and HTML Text- Using Scripts Within a Document Head, Including JavaScript Files, Using Comments, Semicolons, Variables- String Variables, Numeric Variables, Arrays, Variable Typing, Functions, Global Variables, Local Variables, Document Object Model document.write, console.log, alert, Writing into Elements, with Statement, onerror, Using try...catch, Conditionals, Loops.

JavaScript Functions, Objects, and Arrays - JavaScript Functions- Defining a Function, Returning a Value, Returning an Array, JavaScript Objects- Declaring a Class, Creating an Object, Accessing Objects, prototype Keyword, JavaScript Arrays- Numeric Arrays, Associative Arrays, Multidimensional Arrays, Array Methods, Asynchronous Communication - XMLHttpRequest, Sending XML Requests.

Module 4: (14 Hrs)

Introduction to CSS - Importing a Stylesheet, Importing CSS from Within, Embedded Style Settings, Using IDs, Using Classes, Using Semicolons, CSS Rules- Multiple Assignments, Using Comments, Style Types- Default Styles, User Styles, External Stylesheets, Internal Styles, Inline Styles, CSS Selectors- Type Selector, Descendant Selector, Child Selector, ID Selector, Class Selector, Attribute Selector, Universal Selector, Selecting by Group, CSS Cascade-Stylesheet Creators, Stylesheet Methods, Stylesheet Selectors, Measurements, Fonts and Typography- font-family, font-style, font-size, font-weight, Managing Text Styles- Decoration, Spacing, Alignment, Transformation, Indenting, CSS Colors- Short Color Strings, Gradients, Positioning Elements-

Absolute Positioning, Relative Positioning, Fixed Positioning, Pseudoclasses, Box Model and Layout- Setting Margins, Applying Borders, Adjusting Padding, Object Contents.

Module 5: (14 Hrs)

Introduction to jQuery- Including jQuery, jQuery Syntax, Avoiding Library Conflicts, Selectors, CSS Method, Element Selector, ID Selector, Class Selector, Combining Selectors, Handling Events, Event Functions and Properties- blur and focus Events, click and dblclick Events, keypress Event, mouse move Event, Other Mouse Events, Alternative Mouse Methods, submit Event, Special Effects, Hiding and Showing, toggle Method, Fading In and Out, Sliding Elements Up and Down, Manipulating the DOM- text vs html Methods, val and attr Methods, Adding and Removing Elements, Dynamically Applying Classes, Modifying Dimensions, DOM Traversal- Parent Elements, Child Elements, Sibling Elements, Selecting the Next and Previous Elements, Traversing jQuery Selections, is Method, Using jQuery Without Selectors- $.each Method, $.map Method, Asynchronous Communication.

Book of Study

1. Learning PHP, MySQL & JavaScript, Robin Nixon 5th Edition, O'Reilly

References

1. Learn PHP 7: Object-Oriented Modular Programming using HTML5, CSS3, JavaScript, XML, JSON, and MySQL- Steve Prettyman, Apress
2. PHP, MySQL, JavaScript & HTML5 All-in-One for Dummies - Steve Suehring and Janet Valade, Wiley
3. Beginning JavaScript with DOM Scripting and Ajax from Novice to Professional, Christian Heilmann, Apress
4. Beginning jQuery: From the Basics of jQuery to Writing your Own Plug-ins- Jack Franklin Russ Ferguson, Second Edition, Apress
5. Sams Teach Yourself HTML, CSS & JavaScript Web Publishing in One Hour a Day, Seventh Edition

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Course Title : Programming in Java (Core)
Course Code : ICSC5CR3
Credits : 3
Total Hours : 72

Course Objectives

- To familiarize basic concepts of OO programming.
- To understand the concept of constructors, packages and multithreading.
- To inculcate concepts of GUI programming using swing.
- To be able to create applets and implement database connectivity.

Module 1: (10 Hrs)

Concepts of Object-oriented programming, Benefits of OOP, Features of java. Java environment, java tokens, Constant, variables, data types, operators, Command line arguments, Control Statements-branching statements, looping statements, jump statements, labeled loops.

Module 2: (10 Hrs)

Defining a Class, Fields declaration, Method declaration, Creating object, Accessing class members, method overloading, Constructors, constructor overloading, super keyword, static Members, Inheritance, overriding methods, dynamic method dispatch, final (variables, methods and classes), abstract methods and classes, interfaces, visibility control, wrapper classes and methods.

Module 3: (12 Hrs)

Arrays- One dimensional arrays, declaration, creation, initialization of arrays, two dimensional arrays, String class. Packages: - java API packages overview (lang, util, io, awt, swing, applet), user defined packages-creating packages, using packages Exception Handling Techniques-try-catch-throw-throws-finally -Multithreading- creation of multithreaded program-Thread class Runnable interface, Thread life cycle.

Module 4: (10 Hrs)

Event Handling-Delegation Event Model-Event Classes-Sources of Events-Event Listeners- Event classes- Swing- architecture, components of swing- JLabel, JButton, JCheckBox, JRadioButton, JList, JComboBox, JTextField, JText Area, JPanel, JFrame, Layout Managers (Flow Layout, Grid Layout, Card Layout, Border Layout, Box Layout, Null Layout).

Module 5: (10 Hrs)

Applet Fundamentals -applet tag, applet life cycle. Working with graphics -Line, Rectangle, Oval, Arc, color setting. JDBC architecture- JDBC connection, JDBCstatement object, JDBC drivers.

Book of Study

1. E. Balagurusamy- Programming with Java, Third Edition, McGraw Hill Companies.
2. K. Somasundaram - PROGRAMMING IN JAVA2, First Edition, Jaico Publishing House.

References

1. Patrick Naughton - Java2 The Complete Reference, Seventh Edition:
2. Cay S Horstmann & Gary Cornell - Core Java Volume 1- Fundamentals, Eighth edition.
3. Java 6 Programming Black Book 2007 Edition, Dreamtech press.

Course Title : IT and Environment (Core)
Course Code : ICSC5CR4
Credits : 4
Total Hours : 54

Course Objectives

- To understand the importance of internet and use of IT in teaching and learning.
- To identify, formulate and solve environmental problems by utilizing the concept of environmental studies.
- To create awareness among people about protection of wild life & forests.
- To understand the impact of e-waste and use of green computing.
- Understanding of environmental policies and regulations.
- To aware with human rights.

Module 1: Introduction to Internet and Environment (10 Hrs)
Internet- Internet as a knowledge repository, academic search techniques, creating cyber presence. Academic websites. Multidisciplinary nature of environmental studies -Definition, scope and importance, Need for public awareness.

Module 2: Impact of IT in E-Learning: (10 Hrs)
Introduction to use of IT in teaching and learning, Learning Management System, Moodle, Edmodo, etc. Academic services– A note on INFLIBNET, NPTEL, NICNET.

Module 3: IT and Society: (10 Hrs)
IT & Society- issues and concerns- digital divide, IT & development, the free software movement. IT industry: new opportunities and new threats, software piracy, cyber ethics, cybercrime, cyber threats, cyber security, privacy issues, cyber laws, cyber addictions, information overload, health issues guidelines for proper usage of computers, internet and mobile phones. Impact of IT on language & culture.

Module 4: E-waste and Green Computing: (10 Hrs)
E-waste- Problems- Solutions-Impact of e-waste in living beings and environment- a study on e-waste management in India. Green computing, definition, meaning, scope. Green computing in India.

Module 5: Human Rights: (14 Hrs)
An Introduction to Human Rights, Meaning, concept and development –History of Human Rights- Different Generations of Human Rights- Universality of Human Rights- Basic International Human Rights Documents - UDHR, ICCPR, ICESCR. -Value dimensions of Human Rights
Human Rights and United Nations: Human Rights co-ordination within UN system- Role of UN secretariat The Economic and Social Council- The Commission Human Rights-The Security

Council and Human rights The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.

Human Rights National Perspective: Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights- Human Rights of Women- children –minorities- Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.

Case Study:

The students need to view the film "Samaksham", a film on environment produced by Mahatma Gandhi University Creations and submit a compulsory assignment reviewing film. The review is considered for internal mark assessment.

References

1. K.L. James, The Internet: A User's Guide 2nd Revised edition, PHI publication.
2. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB) (https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf).
3. Barkha and U Rama Mohan, Cyber Law & Crimes, 3rd Edition, Asia Law House.
4. Rakesh Johri, E-waste: Implications, regulations, and management in India and current global best practices, Teri publications.
5. Alan Evans, Kendall Martin, Mary Anne Poatsy, Technology in Action, Pearson.

Course Title : Project Minor – Phase I (Project)
Course Code : ICSD5PR5
Credits : -
Total Hours : 54

General guidelines for Phase I and II

Each student needs to undertake a project work to implement various phases of Software Development. The project work is divided into two phases, Phase I in 5th and Phase II in the 6th Semesters respectively.

The Phase I includes Problem identification and statement, system study and system design. For this he/she needs to identify a problem which is not yet automated. Analyze the Manual System existing there and suggest a framework of software befitting the problem. In the fifth semester (Phase I), system must be developed showing the data flow and needed DFD's and Database design. Evaluation of Project-Phase I will be internal for which the student needs to submit a spiral bound report of their work and appear before a team of faculty members formed

by the head of the Department. The team should comprise of the Project Guide and two other Faculty members from the Department.

The Phase II of the project work in the Sixth semester is purely meant for development of software implementing the project identified and designed in Phase I. Student needs to develop a software using any of the Language or Package they have studied in their syllabus. Usage of any other language/package needs to get approved by the Committee/ Project Guide/HoD of the Department No student should be allowed to change the project work in Phase II and they need to develop the software for the work they identified in phase1. The internal mark for the Project work is to be awarded based on the student's performance in Phase I and II (50 percent Weightage for both the semesters). The Sixth semester project evaluation will be of External Nature along with its internal component. Students have to submit a hard bounded report for the evaluation.

The guides may also assign or the student may also choose a research-based project. In Phase I, the students need to choose a research topic, and conduct a detailed literature survey. He/She should frame the objectives of the research, design a high-level methodology that also includes the dataset. This should be submitted as the report and is to be presented for review. The review team should comprise of the Project Guide, and two other faculties from the department.

In Phase II, the detailed implementation of the Methodology should be carried out, followed by the analysis of model performance. The student needs to prepare a research paper and publish it in well-indexed journals. The review of Phase II will be external, where the review panel should comprise of an external reviewer, the project guide and HoD/internal subject expert.

The internal mark for the Project work is to be awarded based on the student's performance in Phase I and II (50 percent Weightage for both the semesters).

Course Title : Software Lab V: Java and PHP (Core Practical)
Course Code : ICSD5CP6
Credits : 3
Total Hours : 144

Course teachers can assign programs subject to their related concepts learnt in the respective theory courses. Atleast 10 programs each of PHP and Java should be submitted for valuation in the practical record. Following topics maybe considered, but not limited to:

I. Java Programming: Lab (72 Hrs)

1. Inheritance, Polymorphism
2. Constructors
3. Interface
4. Package
5. One Dimensional and Two-Dimensional Array Manipulation
6. String Handling (Character Extraction, String Comparison, Searching String, Modifying a String, String Copy)
7. Exception (Built-in and User Defined)

8. Thread (Using Runnable Interface and Thread Class)
9. File management (File reading, Writing, Appending and Content Replacing)

II. Web Application Development Using PHP: Lab (72 Hrs)

Develop programs for implementing the following concepts

1. Expressions and Control Flow in PHP.
2. PHP Functions -Returning a Value, Returning an Array, Passing Arguments by Reference, Returning Global Variables
3. Constructors, Destructors, Inheritance
4. PHP Arrays - Numerically Indexed Arrays, Associative Arrays, foreach Loop, Multidimensional Arrays.
5. MySQL Database - create, insert, delete, update, select operations using HTML form
6. HTML5 Enhancements- autocomplete Attribute, autofocus Attribute, placeholder Attribute, required Attribute, Override Attributes, width and height Attributes, min and max Attributes, step Attribute, form Attribute, list Attribute, colour Input Type, number and range Input Types, Date and Time Pickers
7. JavaScript - Conditionals, Loops, Functions, Objects, and Arrays
8. Asynchronous Communication - XMLHttpRequest, Sending XML Requests,
9. CSS Selectors- Type Selector, Descendant Selector, Child Selector, ID Selector, Class Selector, Attribute Selector, Universal Selector, Selecting by Group.
10. CSS- Fonts and Typography- font-family, font-style, font-size, font-weight, Managing Text Styles- Decoration, Spacing, Alignment, Transformation, Indenting.
11. CSS Colors- Short Color Strings, Gradients
12. Positioning Elements- Absolute Positioning, Relative Positioning, Fixed Positioning.
13. Pseudoclasses,
14. Setting Margins, Applying Borders, Adjusting Padding.
15. JQuery- Selectors, css Method, Element Selector, ID Selector, Class Selector, Combining Selectors
16. JQuery event handling
17. Special Effects, Hiding and Showing, toggle Method, Fading In and Out, Sliding Elements Up and Down.
18. Manipulating the DOM
19. Using jQuery Without Selectors- $.each Method, $.map Method
20. Asynchronous Communication

Semester VI

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSC6CR1	Linux and Shell Programming	3	3	54
2	ICSC6CR2	Computer Networks	4	4	72
3	ICSD6CR3	Mobile Application Development Using Kotlin	4	4	72
4	ICSC6EA1/2/3	Elective 1 [Bunch A]	3	3	54
5	ICSD6PR4	Project Minor Phase II	7	4	126
6	ICSD6CP5	Software Lab VI: Machine Learning Techniques	4	2	72
		Total	25	20	450

Course Title : Linux and Shell Programming (Core)
Course Code : ICSC6CR1
Credits : 3
Total Hours : 54

Course objective

Upon completion of the course, students will be able to:

- gain working knowledge in Linux environment.
- get a clear view on Linux file system
- understand process scheduling in Linux.
- facilities for user creation and management and basics of shell programming.

Module 1: (10 Hrs)

Open Source Software : Free software foundation, Freedoms in free software, GNU project, Introduction and development of Linux, , advantages of Linux, Hardware requirement, Installing Linux, Linux File System overview, Linux Architecture, Boot Process, Kernel, shell - the user interface, GUI and CLI commands, Usage of input-output redirection (>, >> etc.), Basic Commands in Linux – creating directories, changing directories, listing directory contents, file related commands (create and edit text files, renaming, copying, deleting), Introduction to Shells, Different shells and their features, Online manuals in Linux, the Man command.

Module 2: (10 Hrs)

The Linux File system: Partitioning the disk, Disk command, Important files and directories in Linux, the hierarchical file system. The root directory / and its important sub directories /bin, /etc, /dev /lib, /boot /home. /mnt, /tmp, /user. Navigating through the file system. Absolute and relative

pathnames. The disk related commands, df, du, creating new partitions in Linux, deleting a partition, mounting and unmounting file systems , file types, file related commands Find, touch, cat etc. searching for a pattern, concept of wild cards and regular expressions , grep, egrep commands.

Module 3: (12 Hrs)

Process Management in Linux The Concept and properties of Processes, Creating processes, the Parent processes and child processes, PID's and its relevance, Killing processes and sending signals to a process (kill, killall, xkill), How to start and monitor processes, Identify CPU/memory intensive processes, adjust process priority, Processor scheduling in Linux. The Batch command, The at Command, nohup command, File processing commands, wc, cut, paste, sort , Mathematical Commands expr and factor. Different editors in Linux, Consol based editors and GUI based editors and comparison of basic features (Vi, ed, emacs, gEdit etc..).

Module 4: (10 Hrs)

Users and Group Management, useradd, usermod, userdel, groupadd, groupmod, groupdel. Adding a New User Account, User Private Groups, Modifying / Deleting User Accounts, Group Administration, Password Aging Policies, Switching Accounts, passwd command, logging in as Super user, Networked Users and communication, Authentication, Configuration, Default File Permissions, Changing file ownership (chown), Changing file group ownership (chgrp), Permissions on files, Permissions on directories, How permissions are applied, Changing permissions (chmod), Access Control Lists (ACLs).

Module 5: (10 Hrs)

Shell Programming: The role of shells in the Linux environment, : The bash shell, Shell commands, Other standard shells, Write a simple shell script to welcome users, Comments in a script ,Setting up permissions on a script, debug and Execute a script, Variables in shell, The export statement, Unset shell and environment variables, Getting User Input Via Keyboard , Bash variable existence check, Customize the bash shell environments: Recalling command history, Path name expansion, Create and use aliases, The tilde expansion, Startup scripts-(Using aliases, Changing bash prompt, Setting shell options , Setting system wide shell options), Commonly Used Commands and Utilities (ls,rm,cat etc),Developing shell scripts for adding a User, Changing Password of users etc.

Book of Study

1. A Practical Guide to Linux Commands, Editors, and Shell Programming, 4th Edition, by Mark G. Sobell, Matthew Helme, Prentice Hall, 2018. ISBN: 978-0-13-477460-2.
2. The redhat Linux Bible: Christopher Negus: Wiley Dreamtech India
3. Unix Shell Programming: Yeshwant kanetkar. BPB publications.

Course Title : Computer Networks (Core)
Course Code : ICSC6CR2
Credits : 4
Total Hours : 72

Course Objectives

Upon completion of this course, the students will be able to:

- Understand the concepts of signals and OSI layer functions.
- Discuss the process of Multiplexing, switching and difference between guided and unguided media in networks.
- Describe, analyze various data link layer protocols.
- Describe and analyze various network, and transport layer protocols.
- Have a basic knowledge of the use of cryptography and network security.

Module 1: (14 Hrs)

Introduction to Networks, Data and signals-analog and digital, periodic analog signals, digital signals, bit rate, baud rate, bandwidth. Transmission impairments- attenuation, distortion and noise. Data communication protocols and standards, Network models - OSI model-layers and their functions. TCP/IP protocol suite.

Module 2: (12 Hrs)

Bandwidth utilization Multiplexing: FDM, TDM, spread spectrum. Transmission Media- guided media and unguided media. Switching: message, Circuit and packet switched networks, datagram networks, virtual- circuit networks.

Module 3: (16 Hrs)

Data link layer: Error Detection and Correction, Framing, flow and error control, Protocols - Noiseless channels (Simplest, Stop and Wait) and Noisy channels (Stop and Wait and Piggy Backing). Multiple Access Protocols. Random Access-ALOHA, CSMA. Wired LANs- IEEE standards, wireless LANs-Bluetooth, Cellular Telephony

Module 4: (16 Hrs)

Network layer and Transport layer: Repeaters, Bridges, Gateways and routers. Logical addressing – IPV4 and IPV6 addressing, Internet protocol - IPV4 and IPV6. Connectionless and Connection Oriented Services: UDP and TCP. Congestion Control, Quality of Service.

Module 5: (14 Hrs)

Application layer: HTTP, FTP, SMTP, DNS. Network security: Common Threats- Firewalls (advantages and disadvantages), Cryptography.

Book of Study

1. B. A. Forouzan - Data communication and Networking, Fourth edition,TMH
2. Andrew S Tanenbaum - Computer Networks, Fourth Edition, Prentice Hall of India.

Course Title : Mobile Application Development using Kotlin (Core)
Course Code : ICSC6CR3
Credits : 4
Total Hours : 72

Course Objective

Upon successful completion of this course, students should be able to:

- Familiarize with Kotlin programming
- Develop Android applications using Kotlin

Module 1: (10 Hrs)

Kotlin Basics - Characteristics of Kotlin -Program Elements-Literals, Variables, Expressions and Statements, Keywords, Whitespace, Operators, Blocks, Comments, Basic Types-Numbers and Literal Constants, Characters, Booleans, Arrays, Strings and String Templates, Controlling Program Flow - ifs, when Statement, while Statement, for loops, Exception Handling, Handling Nulls.

Module 1: (12 Hrs)

Functions- Declaring Functions, Single Expression Functions, Default Arguments, Named Parameters, Variable Number of Arguments, Extension Functions, Infix Functions, Operator Overloading.

Working with Types- Interfaces, Diamond Problem, Invoking Super Behaviour, Classes- Constructors, Inheritance, Properties, Data Classes, Visibility Modifiers, Access Modifiers, Object Declarations.

Module 3: (12 Hrs)

Lambdas and Higher Order Functions- Higher Order Functions, Lambda and Anonymous Functions, Parameters in Lambda Expressions, Closures, with and apply.

Collections, Arrays - Arrays, Collections, Lists, Sets, Maps, Collections Traversal, Filter and Map. Generics -Why Generics, Terminologies, Using Generics in Functions, Using Generics in Classes, Variance, Subclass vs Subtype, Reified Generics.

Module 4: (10 Hrs)

Activities and Layouts -Activity Class, Layout File, View and ViewGroup Objects, Containers, Event Handling-Introduction to Event Handling, Intents- Definition, Loose Coupling, Types of Intent- Explicit, Implicit Intents, Fragments.

Running in the Background- Basic Concepts, UI Thread, Threads and Runnables , Handler Class, Async Task, Anko’s doAsync.

Module 5: (10 Hrs)

Data sharing and Storage -Shared Preferences, Sharing Data Between Activities, Internal Storage- Overview of File Storage, Internal and External Storage, Cache Directory.

Broadcast Receivers- Introduction to Broadcast Receivers, System Broadcast vs Custom Broadcast, Manifest Registration vs Context Registration, Basics of Broadcast Receivers, Implicit vs Explicit Broadcast Actions.

Book of Study

1. Learn Android Studio 3 with Kotlin: Efficient Android App Development - Ted Hagos, Apress, Inc.

References

1. Android Development with Kotlin - Marcin Moskala, Igor Wojda, Packt.
2. Kotlin In-Depth [Vol-I] -A Comprehensive Guide to Modern Multi-Paradigm Language - Aleksei Sedunov, BPB Publications.
3. Learn Kotlin for Android Development- The Next Generation Language for Modern Android Apps Programming, Peter Spath, Apress.
4. Programming Kotlin Applications- Building Mobile and Server-Side Applications with Kotlin, By Brett McLaughlin, Wiley.

Course Title : Project Minor – Phase II (Project)
Course Code : ICSD6PR4
Credits : 4
Total Hours : 126

General guidelines for Phase I and II

Each student needs to undertake a project work to implement various phases of Software Development. The project work is divided into two phases, Phase I in 5th and Phase II in the 6th Semesters respectively.

The Phase I includes Problem identification and statement, system study and system design. For this he/she needs to identify a problem which is not yet automated. Analyze the Manual System existing there and suggest a framework of software befitting the problem. In the fifth semester (Phase I), system must be developed showing the data flow and needed DFD's and Database design. Evaluation of Project-Phase I will be internal for which the student needs to submit a spiral bound report of their work and appear before a team of faculty members formed by the head of the Department. The team should comprise of the Project Guide and two other Faculty members from the Department.

The Phase II of the project work in the Sixth semester is purely meant for development of software implementing the project identified and designed in Phase I. Student needs to develop a software using any of the Language or Package they have studied in their syllabus. Usage of any

other language/package needs to get approved by the Committee/ Project Guide/HoD of the Department No student should be allowed to change the project work in Phase II and they need to develop the software for the work they identified in phase1. The internal mark for the Project work is to be awarded based on the student's performance in Phase I and II (50 percent Weightage for both the semesters). The Sixth semester project evaluation will be of External Nature along with its internal component. Students have to submit a hard bounded report for the evaluation.

The guides may also assign or the student may also choose a research-based project. In Phase I, the students need to choose a research topic, and conduct a detailed literature survey. He/She should frame the objectives of the research, design a high-level methodology that also includes the dataset. This should be submitted as the report and is to be presented for review. The review team should comprise of the Project Guide, and two other faculties from the department.

In Phase II, the detailed implementation of the Methodology should be carried out, followed by the analysis of model performance. The student needs to prepare a research paper and publish it in well-indexed journals. The review of Phase II will be external, where the review panel should comprise of an external reviewer, the project guide and HoD/internal subject expert.

The internal mark for the Project work is to be awarded based on the student's performance in Phase I and II (50 percent Weightage for both the semesters).

Course Title : Software Lab VI – Mobile Application Development using Kotlin (Core Practical)
Course Code : ICSD6CP5
Credits : 2
Total Hours : 72

Develop 10 to 12 GUI programs for android operating system that implements at least the following concepts:

1. Lambdas and Higher Order Functions
2. Collections, Arrays
3. Generics
4. Layouts, Activities, Intent, Fragments
5. UI Thread, Threads and Runnables, Handler Class
6. Async Task, Anko's doAsync.
7. Shared Preferences
8. Broadcast Receivers (System Broadcast, Custom Broadcast).

Semester VII

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSC7CR1	Computational Mathematics	4	4	72
2	ICSD7CR2	Applied Statistics for Data Science	4	4	72
3	ICSD7CR3	Advanced Python Programming for data Science	4	4	72
4	ICSD7CR4	Data Engineering in Data Science	4	3	72
5	ICSD7CP5	Software Lab VII: Python Programming Lab for data Science	5	3	90
6	ICSD7CP6	Software Lab VIII: Data Engineering Lab	4	2	72
		Total	25	20	450

Course Title : Computational Mathematics (Core)
Course Code : ICSC7CR1
Credits : 4
Total Hours : 72

Course objectives

Upon successful completion of this course, students should be able:

- To Understand set relations and functions, Use of Permutation and Combination for arranging objects.
- To do Predicate and Propositional Calculus for Precise reasoning.
- To Gain the methods of fuzzy logic, use the fuzzy set theory, and recognize fuzzy logic membership function, Understand Fuzzification and Defuzzification.
- To understand different concepts in automata theory and formal languages and determine solution to simple automata problems.
- To recognize real-world problems that are amenable to mathematical analysis, and formulate mathematical models of such problems

Module 1:

Sets, Relations and Functions: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering, Functions, Domain and Range, Types of Functions.
Counting and Mathematical Induction: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction.

Module 2:

Mathematical Logic: Propositional Calculus: Statements and notations, Connectives: negation, conjunction, disjunction, statement formulas and truth tables, conditional and biconditional, Well-formed formulas, tautologies, equivalence of formulas, tautological implication. Normal forms: Disjunctive and conjunctive normal forms.
Predicate calculus: Predicates, statement functions, variables and quantifiers, predicate formulas, free & bound variables, universe of discourse.

Module 3:
Fuzzy Logic:- Fuzzy Set Theory :- Fuzzy Versus Crisp – Crisp sets – Operations on Crisp Sets, Properties of Crisp Sets , Fuzzy Sets, Basic Fuzzy Set Operations, Properties of Fuzzy Sets – Crisp Relations, Operations on Crisp Relations - Fuzzy Relations –Operations on Fuzzy Relations , Properties, Membership Functions, Fuzzification, Defuzzification Methods.

Module 4:
Theory of Automata: Definition, Description of finite automata, Transition system and its properties, Acceptability of a string by a finite automaton, NFA, Equivalence of DFA and NFA, Minimization of finite automata, Construction of minimum automaton.
Regular sets and Regular grammars: Regular expressions, identities for regular expressions, finite automata and regular expressions, transition system containing ^-moves, conversion of nondeterministic systems to deterministic systems, Algebraic method using Arden‘s theorem, Construction of finite automata equivalent to a regular expression.

Module 5:
Languages and grammars: Basic definition and example, Definition of a grammar, derivation and the language generated by a grammar, Chomsky classification of languages, Context free languages and derivation trees

References

1. J.P. Tremblay & R Manohar- Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill.
2. K.L.P Mishra & N. Chandrasekaran -Theory of Computer Science (Automata, Languages and Computation), Prentice Hall of India.
3. George J Klir& Bo Yuan- Fuzzy sets and Fuzzy logic Theory and applications, Prentice Hall of India.
4. Fuzzy Set Theory, Fuzzy Logic & Their Applications; Dr A K Bhargava- S Chand Publications.
5. Discrete Mathematics and Its Applications; Kenneth H. Rosen and Kamala Krithivasan- McGraw-Hill Publishers.

Course Title : Applied Statistics for Data Science (Core)
Course Code : ICSC7CR2
Credits : 4
Total Hours : 72

Course Objectives

- A student would have in depth understanding of the key statistical concepts for applying strong knowledge base in Analytics domain.
- Students will learn to apply various statistical theories to solve real life situations by doing projects.
- Students will learn to apply R as a tool for statistical application.

Module 1:

Inferential Statistics: Unbiased Estimation, maximum likelihood estimators, Minimum variance unbiased estimators, Existence and construction of sufficient statistics, Complete family of distributions. Cramer Rao inequality, Rao-Blackwell theorem.

Module 2:

Time series Analysis: Time series as stochastic process, stationary time series- covariance stationarity, Modelling Time Series Data, Exponential Smoothing Methods - First-Order and Second order Exponential Smoothing, Forecasting, Exponential Smoothing for Seasonal Data, Exponential Smoothers, Autocorrelation function (ACF), partial auto correlation function (PACF), correlogram, AR, MA, ARMA, ARIMA Models, Yule- Walker equations, Box-Jenkins Model fitting and diagnostics. Forecasting future values,

Module 3:

Bayesian statistics: Bayesian parametric models, conjugate prior, Bayesian estimators – Hypothesis testing: testing framework, parametric testing, permutation test, multiple testing.

Module 4:

Design of Experiments: Basic principles of experimental design, uniformity trails, analysis of variance, one-way, two-way and three-way classification models, completely randomized design (CRD), randomized block design (RBD) Latin square design (LSD) and Graeco-Latin square designs, Analysis of covariance (ANCOVA), ANCOVA with one concomitant variable in CRD and RBD.

Module 5:

Probability and Statistics in R, Distributions, Hypothesis Tests in R, Simulation, Modeling, Estimate and visualize a regression model using R.

References

1. 1.Peng R. D, Exploratory data analysis with R, Lulu.Com, 2012.
2. Peng R. D, R programming for data science, Leanpub, 2016.
3. Teetor P, R cookbook: Proven recipes for data analysis, statistics, and graphics, O' Reilly Media Inc., 2011.
4. Crawley M. J., The R book, John Wiley & Sons, 2012.
5. Montgomery D. C., Cheryl L. J., and Murat K. (2015) Introduction to Time Series Analysis and Forecasting. John Wiley & Sons.
6. Brockwell P.J and Davis R.A. (2002) Introduction to Time Series and Forecasting Second edition, Springer-Verlag.
7. Ruey S. Tsay (2005). Analysis of Financial Time Series, Second Ed. Wiley & Sons.
8. Abraham, B., &Ledolter, J. (2009). Statistical methods for forecasting (Vol. 234). John Wiley & Sons.
9. Chatfield, C. (2004). The Analysis of Time Series - An Introduction (Sixth edition), Chapman and Hall.
10. 10.Berger, J. O. (2013). Statistical decision theory and Bayesian analysis. Springer Science & Business Media.
11. Raaiffe H. & Schlaiffer R. (2000) Applied Statistical Decision Theory, M.T.Press.
12. Das M.N. and Giri N.C. (1994) Design and analysis of experiments, Wiley Eastern Ltd.
13. 13.Montgomery, C.D. (2012) Design and Analysis of Experiments, John Wiley, New York.
14. Dean, A. and Voss, D. (1999) Design and Analysis of Experiments, Springer Texts in Statistics.
15. 15.S. C. Gupta and V.K.Kapoor (2017) Fundamentals of Mathematical Statstics, Sultan Chand & Sons.

Course Title : Advanced Python Programming for Data Science (Core)
Course Code : ICSC7CR3
Credits : 4
Total Hours : 72

Course Objectives

On completion of course, students should be able:

- To learn about some Python functionality and techniques that are commonly used.
- To understand and use functionality of various Python libraries for different scientific and mathematical tasks.
- To gain basic insight of implementation of advanced concepts and use of various libraries for applying Machine Learning for problem solving.
- To acquire knowledge about the frameworks in Python.
- To analyze large data sets in Python fro data science.

Module 1:
Introduction: Review of Important Python Concepts, Overview of Advanced techniques in Python: Lambdas, Filter and map, is and id, Decorators, Iterators and Generators, Garbage Collector, environment, Exception handling, Interop module, Pickle, Marshal, Networking Concepts, Process and Threads, Sockets, Regular Expression, Heuristic search techniques.

Module 2:
Scientific and Numerical Computing with Python: Introduction to Scientific and Numerical computing, Introduction to various modules used for Scientific and Numerical programming: NumPy, SciPy, Scikit-Learn, MatplotLib and Keras & Pandas, Introduction of Internal Statistics, overview of common approaches to multivariate statistics.

Module 3:
Introduction to Processing of Data Sets: Overview of various Data sets, Data handling Techniques: using Structured and unstructured Files, Excel and SQL Files. Data Preprocessing and Data Analysis using Pandas and Seaborn, Data Visualization, Exploring duplicate data and missing data, Data fitting concepts, Introduction to collection modules, counter, data storage offline.

Module 4:
Introduction to Frameworks used with Python – TensorFlow: Concept of Computational Graph and Nodes Virtual Environment and Anaconda, Installing TensorFlow with GPU support on a Linux System, TF Datatypes, Placeholders, TF Variables, TF Session, Softmax, One Hot Encoding, Dropout, building hidden layers, Batching, Stochastic Gradient Descent, Building an Optimizer, Training and displaying outcome, Overview of various python frameworks

Module 5:
Implementation of Machine Learning concepts in Python: Introduction to Machine Learning Approaches, Overview of ML tasks: Supervised Learnings: Classifications, Regression. Unsupervised Learnings: Clustering, Semi-supervised Learning, Reinforcement Learning, Basics of implementation of Machine Learning modules using Python.

References

1. Rao N.R., “Core Python Programming”, Dreamtech Publication India
2. Sarker M.O.F., “Python Network Programming Cookbook”, Packt Publication
3. Sebastian Raschka, “Python Machine Learning”, Packt Publication
4. Willi Richert, “Building Machine Learning Systems with Python”, Packt publication
5. Fredrik Lundh, “Python Standard Library”, O’Reilly Publications
6. Halterman R.,”Fundamentals of Python Programming”, Southern Adventist University
7. Guttag J.V., “Introduction to Computation and Programming Using Python”, Prentice Hall India
8. Chun W., “Core Python Programming”, Prentice Hall India

Course Title : Data Engineering (Core)
Course Code : ICSC7CR3
Credits : 4
Total Hours : 72

Course Objectives

- General concepts in representing data, accessing it and analysing it.
- Provide application side of query processing, data Wrangling, Cleaning etc.
- Able to develop suitable data science ecosystem for the given application.
- Understand various data storage and retrieval techniques.
- Analyzing of data using Python and Data Wrangling.

Module 1:

Introduction: Data source, Big Data, Structured and unstructured data. Data Models and Storage: Relational databases, NoSQL database, normalized and denormalized data models, Data cleaning, Distributed Data Storage and Management – Data fragmentation and replication, Hashing, Indexing.

Module 2:

Query processing: Querying big data using SQL and NoSQL, Elastic Search, Query Processing, Query optimization – Translating SQL queries into relational algebra – Heuristic based query optimization – cost based query optimization, Distributed Query processing – the distributed join problem, Semi-join reductions, joining of many relations – Acyclic hypergraphs.
Data Warehousing: OLAP, OLTP.
Streaming Data analytics: Introduction, Querying a stream, Windowing techniques, Summarization techniques, data pipelines and dashboards, In-memory analytics, Predictive Analytics (6 Lectures)

Module 3:

Data Wrangling - Importance of Data Wrangling - Tasks of Data Wrangling-Data Wrangling Tools-Introduction to Python-Python Basics-Data Meant to Be Read by Machines-CSV Data-JSON Data-XML Data.
Data Cleanup Basics-Identifying Values for Data Cleanup-Formatting Data-Finding Outliers and Bad Data-Finding Duplicates-Fuzzy Matching-RegEx Matching-Normalizing and Standardizing the Data-Saving the Data-Determining suitable Data Cleanup-Scripting the Cleanup Testing with New Data.

Module 4:

Exploring Data-Importing Data-Exploring Table Functions-Joining Numerous Datasets-Identifying Correlations-Identifying Outliers-Creating Groupings-Analyzing Data-Separating and Focusing the Data -Presenting Data-Visualizing the Data-Charts-Time-Related Data-Maps-

Interactives-Words-Images, Video, and Illustrations-Presentation Tools-Publishing the Data-Open-Source Platforms.

Module 5:

Web Scrape -Analyzing a Web Page-Network/Timeline-Interacting with JavaScript-In-Depth Analysis of a Page-Getting Pages-Reading a Web Page-Reading a Web Page with LXML-XPath-Advanced Web Scraping-Browser-Based Parsing-Screen Reading with Selenium-Screen Reading with Ghost. PySpidering the Web-Building a Spider with Scrapy-Crawling Whole Websites with Scrapy.

References

1. M. KLEPPMANN (2017), Designing Data-Intensive Applications the Big Ideas Behind Reliable, Scalable, And Maintainable Systems, O'Reilly.
2. L. WEISE (2015), Advanced Data Management: For SQL, Nosql, Cloud and Distributed Databases, Walter De Gruyter Gmbh.
3. A. SILBERSCHATZ, H.F. KORTH, S. SUDARSHAN (2011), Database System Concepts, Mcgraw Hill Publications, 6th Edition.
4. Jacqueline Kazil & Katharine Jarmul," Data Wrangling with Python", O'Reilly Media, Inc,2016
5. H.G. MOLINA, J. ULLMAN, J. WIDOM (2014), Database Systems: The Complete Book, Pearson, 2nd Edition.
6. P. RAJ, A. RAMAN, D. NAGARAJ, S. DUGGIRALA (2015), Hig

Course Title : Software Lab VII: Advanced Python Lab for Data Science (Core Practical)
Course Code : ICSC7CP5
Credits : 3
Total Hours : 90

Course Objectives

Student will get acquainted with the various libraries and functions in python to help to understand the Data Science and machine Learning concept better.

Course Content

1. Usage of libraries Pyspark, Numpy, Scipy, Matplotlib, Pandsas, Python Script and Variable.
2. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.Reading Excel data sheet
3. Descriptive Statistical Analysis – Evaluation, Plotting and Interpretation Linear Regression: Read a data frame in csv/xls format containing the weather data such as

pressure, min temp, max temp, humidity, and rainfall. Using the Pandas, MatPlotlib and SciPy plot the scatter plots and develop a linear interpolation between rainfall with all other parameters and evaluate the statistical significance of the model.

4. Creation of python programs on the modules Numpy Analyse the given series of data using pandas Python programs that uses the dictionaries, tuples and other data structures
5. Decision Tree Classification, attribute selection measures, and how to build and optimise Decision Tree Classifier using Python Scikit-learn
6. Apply regression Model techniques to predict the data
7. a) Install relevant classification packages.
   b) Choose a classifier for the classification problem.
   c) Evaluate the performance of the classifier.
8. Clustering algorithms for unsupervised classification. Plot the cluster data using python with Matplotlib visualizations.

Course Title : Software Lab VIII: Data Engineering Lab (Core Practical)
Course Code : ICSC7CP6
Credits : 2
Total Hours : 72

Course Objectives

- Perform Read and write operations on CSV, JSON and XML files
- Process the Excel file using Pandas
- Parse and Extract the Tables using Python library
- Apply the basis of Data cleanup operation on the given dataset
- Explore the web scraping in Python

The following programs may be considered while designing the lab manual:

1. Write programs to parse text files, CSV, HTML, XML and JSON documents and extract relevant data. After retrieving data check any anomalies in the data, missing values etc.
2. Design a relational database for a small application and populate the database. Using SQL do the CRUD (create, read, update and delete) operations.
3. Import any CSV file to Pandas DataFrame and perform the following:
   (a) Handle missing data by detecting and dropping/ filling missing values.
   (b) Transform data using apply() and map() method.
   (c) Detect and filter outliers.
   (d) Perform Vectorized String operations on Pandas Series.
   (e) Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.
4. Write a Python script to read each row from a given csv file and print a list of strings.
5. Write a Python program to read a given CSV file as a dictionary.

6. Write a Python program to convert Python dictionary object (sort by key) to JSON data. Print the object members with indent level 4
7. Write the python script to Read the XML file
8. Write a Pandas program to import excel data (child labour and child marriage data.xlsx) into a Pandas data frame and process the following a. Get the data types of the given excel data b. Display the last ten rows. c. Insert a column in the sixth position of the said excel sheet and fill it with NaN values
9. Develop the python script to parse the pdf files using pdfminer.
10. Extract the Table from the child labour and child marriage data.xlsx using pdfables library
11. Write a Python data wrangling scripts to insert the data into SQLite database
12. Develop the Python Shell Script to do the basic data cleanup on child labour and child marriage data.xlsx a. Check duplicates and missing data b. Eliminate Mismatches c. Cleans line breaks, spaces, and special characters
13. Import the data into `agate`then explores the table using agate methods and perform statistical correlations
14. Draw the chart between perceived corruption scores compared to the child labour percentages using matplotlib.
15. Write the python script to Map the Child Labour Worldwide using pygal.
16. Write a Python program to download and display the content of robot.txt for en.wikipedia.org

Semester VIII

Sl. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSD8EB1/2	Elective 2 [Bunch B]	4	4	72
2	ICSC8CR1	Advanced Deep Learning Techniques	4	4	72
3	ICSD8CR2	Data Visualization	4	4	72
4	ICSD8EC1/2	Elective 3 [Bunch C]	4	4	72
5	ICSD8CP3	Software Lab IX: Deep Learning Lab using R	4	2	72
6	ICSD8CP4	Software Lab X: Data Visualization Lab using Tableau	5	2	90
		Total	25	20	450

Course Title : Advanced Deep Learning Techniques (Core)
Course Code : ICSC8CR1
Credits : 4
Total Hours : 72

Course Objectives

- To understand the theoretical foundations, algorithms and methodologies of Neural Network
- To design and develop an application using specific deep learning models
- To provide the practical knowledge in handling and analyzing real world applications

Module 1: Deep Learning Architectures (14 Hrs)
Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications.

Module 2: Convolutional Neural Networks (14 Hrs)
Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications.

Module 3: Transfer Learning (14 Hrs)
Transfer learning Techniques, Working, Approaches in Transfer Learning, Variants of CNN: DenseNet, PixelNet.

Module 4: Sequence Modelling – Recurrent and Recursive Nets. (16 Hrs)
Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks. Auto Encoders:

Under complete Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders.

Module 5: LSTM, GRU (14 Hrs)
Image Segmentation, Image classification, Object Detection, Automatic Image Captioning, Image generation with Generative Adversarial Networks, LSTM as a classifier Model, Attention Models for Computer Vision.

References

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
4. Deep learning - Heaton, J. Ian goodfellow, yoshua bengio, and aaron courville, The MIT Press, First Edition

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Course Title : Data Visualization (Core)
Course Code : ICSC8CR2
Credits : 4
Total Hours : 72

Course Objectives

- To expose to visual representation methods and techniques that increase the understanding of complex data.
- To study good design practices for visualization.
- Practice the core principles using widely available tools like Tableau.
- Apply fundamental concepts of data visualization on projects.

Module 1: **Introduction to Data Visualisation**
Definition – Methodology – Seven Stages of Data Visualisation - Data Visualisation Tools. Visualising Data: Mapping Data onto Aesthetics – Visualising Amounts - Visualising Distributions: Histograms and Density Plots – Visualising Propositions: – Visualising Associations: Among Two or More Quantitative Variables – Visualising Time Series and Other Functions of an Independent Variable – Trends – Visualising Geospatial Data.

Module 2: **R: Interactive Data Visualisation**
Introduction to D3 - Fundamental Technology: The Web – HTML – DOM – CSS – JavaScript – SVG. D3 Setup – Generating Page Elements – Binding Data - Drawing with data – Scales: Domains and Ranges – Normalization – Creating a Scale – Scaling the Scatter Plot – Other

Methods and Other Scales. Axes – Modernizing the Chart – Update the Data – Transition – Updates – Interactivity.

Module 3: **D3 Based Reusable Chart Library**

Setup and Deployment – Generate Chart – Customize Chart: Additional Axis – Show Axis Label – Change Chart Type – Format Values – Size – Color – Padding –Tooltip. Use APIs: Load and Unload – Show and Hide – Focus – Transform – Groups – Grid – Regions – Flow – Revert – Toggle –Legend – Sub chart – Zoom – Resize. Customize Style. Building Real time and Live Updating animated graphs with C3.

Module 4: **Tableau Introduction**

Environment Setup – Navigation – File & Data Types. TA SOURCE: Custom Data View – Extracting Data – Fields Operations – Editing Meta Data – Data Joining – Data Blending. Worksheets.

Module 5: **Basic and Advanced Charts in Tableau**

Bar Chart – Line Chart – Pie Chart – Scatter Plot – Bubble Chart –Gantt Chart – Histograms - Waterfall Charts. Dashboard – Formatting – Forecasting – Trend Lines.

References

1. Ben Fry, "Visualizing Data: Exploring and Explaining Data with the Processing Environment", O'Reilly, 1st Edition, 2008.
2. Scott Murray, "Interactive data visualization for the web: An Introduction to Designing with D3", O'Reilly, 2nd Edition, 2017.
3. Joshua N. Milligan, "Learning Tableau 2019: Tools for Business Intelligence, data prep, and visual analytics", Packt Publishing Limited, 2019.
4. Claus O. Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", O.Reilly, 2019.

Course Title : Software Lab IX: Deep Learning Lab using R (Core Practical)
Course Code : ICSC8CP3
Credits : 2
Total Hours : 72

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1. Implement a four layer deep neural network model for classification / regression. Compare the performance of the model by using various activation functions like RELU, LRELU, ERELU.
2. Implement an autoencoder model for feature extraction.
3. Implement an image classifier using CNN.
4. Design a pretrained model for image classification. Compare the performance using various pretrained models like ResNet, AlexNet and DenseNet
5. Implement a temperature predictor using RNN and LSTM. Include a comparison of performance when we used RNN and LSTM.

6. Design a model for Automatic Image Captioning using GRU

Course Title : Software Lab IX: Deep Learning Lab using R (Core Practical)
Course Code : ICSC8CP4
Credits : 2
Total Hours : 90

1. Creating interactive data visualization (2D visualization) in the browser using D3.
2. Create D3-based reusable charts that enables deeper integration of charts into web applications.
3. Drawing histograms, density plots and scatter plots using Tableau

Semester IX

Si. No.	Course Code	Title	Hrs./Week	Credits	Total Hours
1	ICSD9ED1/2	Elective 4 [Bunch D]	4	4	72
2	ICSD9CR1	Text Analytics & Natural Language Processing	4	3	72
3	ICSD9CR2	Web Analytics	4	4	72
4	ICSC9EE1/2	Elective 5 [Bunch E]	4	4	72
5	ICSD9CP3	Software Lab XI: NLP using R	4	2	72
6	ICSD9PR4	Case study and Minor project	5	3	90
		Total	25	20	450

Course Title : Text Analytics & Natural Language Processing (Core)
Course Code : ICSD9CR1
Credits : 3
Total Hours : 72

Course Objectives

- Text analytics concepts and applications
- Fundamental of Information retrieval and natural language processing
- Text analytics framework
- Theoretical techniques and applications in text analytics (e.g. social media)

Module 1:
Introduction to Natural Language Processing-History of NLP, Text Analytics and NLP, Various Steps in NLP, Kick Starting an NLP project.
Types of Data-Structured, Semi Structured and Unstructured Data, Categorization of Data Based on Content

Module 2:
Basic Feature Extraction Methods-Cleaning Text Data-Tokenization, Feature Extraction from Texts, Feature Engineering.
Natural Language Processing and Python-Lists, Regular Expressions, Dictionaries, Writing Functions, Text Wrangling and Cleansing.

Module 3:
Building a Custom Corpus-Domain Specific Corpora, Corpus Data Management-Corpus Disk Structure.

Corpus Preprocessing and Wrangling- Breaking Down Documents, Corpus Transformation- Intermediate Preprocessing and Storage, Reading the Processed Corpus.

Module 4:
Classification for Text Analysis- Text Classification, Building a Classification Application- Cross Validation, Model Construction, Model Evaluation, Model Operationalization

Module 5:
Context-Aware Text Analysis- Grammar-Based Feature Extraction, n-Gram Feature Extraction, n-Gram Language Models.
Text Visualization-Visualizing Feature Space, Visualizing Clusters, Visualizing Classes.

References

1. Sohom Ghosh, Dwight Gunning, "Natural Language Processing Fundamentals", Packt Publishing.
2. Nitin Hardeniya, Jacob Perkins, Deepti Chopra, Nisheeth Joshi, Iti Mathur, "Natural Language Processing: Python and NLTK", Packt Publishing
3. Benjamin Bengfort, Rebecca Bilbro, and Tony Ojeda, "Applied Text Analysis with Python Enabling Language-Aware Data Products with Machine Learning", O'Reilly

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Course Title : Web Analytics (Core)
Course Code : ICSD9CR2
Credits : 3
Total Hours : 72

Course Objectives

- To provide common overview of web analytic activities
- Having problem solving ability- web analytics solutions.
- Ability to use web analytics Tools like Google Analytics, Yahoo Analytics

Module 1:
Introduction to Web Analytics: Definition, Types of Web Analytics, User Experience and Web Analytics Questions., A brief history of web analytics, Current Landscape and Challenges, Traditional Web analytics, Web analytics Activities, Measuring, Trinity.
Basic metrics of web analytics- Pageviews -Bounce rate −Pages per session − Demographic info – Devices. Source: Traffic sources − Organic traffic -Social traffic -Referral Direct traffic. Micro and Macro–Level Data Insights.
Data collection: Understanding the Data Landscape, Click stream Data, Outcomes Data, Research Data, Competitive Data.

Module 2:

Web Analytics Approach: Introduction, A model of Analysis, Showcasing the work, Context Matters, Contradicting the data. Working of Web Analytics: Introduction, Log File Analysis, Page Tagging, Metrics and Dimensions, Interacting with data in Google Analytics.

Module 3:

Introduction to Goals and Conversions-, Definition of Goals and Conversions, Conversion Rate, Goal Reports in Google Analytics, Finding the right things to measure as key, Performance Indicators, Measure on a website that can constitute a goal. Learning about users: Introduction, Visitor Analysis.

Module 4:

Introduction: Search Query, Source and medium, Organic Search, Search Query -Navigational-Informational-Transactional, Search Query Analysis, Referral Traffic, Direct Traffic, Paid Search Keyword. Analyzing usage of content: introduction, Website content Reports

Module 5:

Click-Path Analysis: Introduction, Focus on Relationships between pages, Navigation Summary, Visitors Flow Report, analyzing how users move from one page type to another.
Segmentation: Introduction, Necessity, Procedure to segment, Ways to Segment, Useful ways to segmentUX questions.
Tools -Google Analytics – Piwik Web Analytics – Yahoo Web Analytics – Emerging Analytics: Social - Video - Mobile.

References

1. Avinash Kaushik - "Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity" - 1st Edition - Sybex - 2009.
2. Avinash Kaushik - "Web Analytics: An Hour a Day" - 6th Edition - Sybex - PAP/ CDR Edition - 2007.
3. Brian Clifton - "Advanced Web Metrics with Google Analytics" - 3rd Edition- Sybex - 2012.

Course Title : Software Lab XI (Core Practical)
Course Code : ICSD9CP3
Credits : 2
Total Hours : 72

The candidate needs to submit a Lab Record, duly signed by the teacher in charge and Head of the Department, (minimum of 10 Programs), failing which he/she will not be allowed to attend the external software lab examination. The Lab record should be hard-binded with the name of college and the emblem of the college depicted on the first page and should be properly indexed.

1. Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
2. Morphological Analysis
3. N-gram model
4. POS tagging
5. Chunking
6. Named Entity Recognition
7. Virtual Lab on Word Generator and Word Analysis
8. Morphology
9. N-Grams
10. N-Grams Smoothing
11. Building POS Tagger
12. Building Chunker

Course Title : Case Study and Minor Project (Project)
Course Code : ICSD9CP4
Credits : 3
Total Hours : 90

Case study and Minor Project aims at giving students hands-on experience in applying the programming knowledge to develop a real application for data science, based on the case study conducted by the student on a real-world scenario. Students must take up individual projects. Evaluation of the project is external. The case study has to be presented in the project report, and submitted in hard bound format for evaluation.

The students will work on multiple case studies and projects from different domain specified by guide allotted to him. This course aims at discussing the key principles of knowledge discovery process through various case studies arising from different application areas. The students are expected to learn the main steps to traverse when they face new data analytics problems. With each case study, the tools for cleaning, processing and altering the data shall be visited. A particular attention shall be given to data inspection, feature reduction and model selection. Each case study will be completed by a thorough discussion and interpretation of the results.

Semester X

Si. No.	Course Code	Title	Hrs./Week	Credits	Total Hours
1	ICSDXPR1	Major Project	25	16	450
2	ICSDXVV2	Comprehensive Viva Voce		4	
		Total	25	20	450

Course Title : Major Project (Project)
Course Code : ICSDXPR1
Credits : 16
Total Hours : 450

Industry or research internship should include partial/complete project implementation. Student should beallocated to the research guide in 7th semester itself and same guide should be continued for the**:** Industry Internship/ In house Research Project. Otherwise, the preferences/choices of the domain should be taken from the students. The guide needs to be allocated based on the preference/choices. The research project should be assigned to students. In case of Industry Internship, the assigned guide from college hasto monitor and evaluate the progress of the student. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation. The continuous assessment of the progress needs to be documented unambiguously.

Course Title : Comprehensive Viva Voce (Viva Voce)
Course Code : ICSDXVV2
Credits : 4
Total Hours : -

The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Computer Science acquired over 5 years of study in the integrated programme. The viva shall normally cover the subjects taught in all the semesters of programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

Elective: Bunch A

Course Title : Cloud Computing (Elective)
Course Code : ICSC6EA1
Credits : 3
Total Hours : 54

Course Objectives

Cloud computing has evolved as a very important computing model, which enables information, software, and shared resources to be provisioned over the network as services in an on-demand manner. On completion of this course provides an insight into what is cloud computing and the various services cloud is capable.

Module 1:
Introduction to Computing Paradigms, High-Performance Computing, Parallel Computing., Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing., Biocomputing, Mobile Computing, Quantum Computing, Optical Computing. Nanocomputing.
Introduction: Benefits and Limitations-Cloud Architecture – Storage – Services –Service Providers - Types of Cloud Service Development – Services and Tools

Module 2:
Collaborating on Contact Management - Collaborating on Project Management- Collaborating on Word Processing, Spreadsheet, Presentations, Databases- Sharing Files and Photographs

Module 3:
Cloud Virtualization Technology – Virtualization Defined – Virtualization Benefits – Server Virtualization– Virtualization for x86 Architecture – Hypervisor Management Software – Logical Partitioning – VIO Server – Virtual Infrastructure Requirements

Module 4:
Deep Dive: Cloud Virtualization –Introduction - Storage Virtualization–Storage Area Networks– Network Attached Storage – Cloud Server Virtualization – Virtualized Data Center

Module 5:
Industrial platforms and new developments - Amazon web services: Compute services - Storage services- Communication services - Additional services - Google AppEngine: Architecture and core concepts - Application life cycle - Cost model Microsoft Azure: Azure core concepts - SQL Azure - Windows Azure platform appliance

References

1. Essentials of cloud Computing : K.Chandrasekhran , CRC press, 2014

2. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
3. Cloud Computing: Insights into New Era Infrastructure, Dr. Kumar Saurabh (2011). , Wiley India,
4. Mastering Cloud Computing Foundations and Applications Programming, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi (2013).
5. Cloud Computing: Fundamentals, Industry Approach and Trends, Rishabh Sharma (2014),Wiley India edition.

Course Title : Full - Stack Development (Elective)
Course Code : ICSC6EA2
Credits : 3
Total Hours : 54

Course Objectives

Learner can:

- Identify Structure and implementation of HTML/CSS.
- Apply intermediate and advanced web development practices.
- Implement basic JavaScript.
- Create visualizations in accordance with UI/UX theories.
- Develop a fully functioning website and deploy on a web server.

Module 1: HTML and CSS

Introduction to HTML, Browsers and HTML, Editor's Offline and Online, Tags, Attribute and Elements, Doctype Element, Comments, Headings, Paragraphs, and Formatting Text, Lists and Links, Images and Tables.

Introduction CSS, Applying CSS to HTML, Selectors, Properties and Values, CSS Colors and Backgrounds, CSS Box Model, CSS Margins, Padding, and Borders, CSS Text and Font Properties, CSS General Topics.

Module 2: JavaScript

Introduction to JavaScript, Applying JavaScript (internal and external), Understanding JS Syntax, Introduction to Document and Window Object, Variables and Operators, Data Types and Num Type Conversion, Math and String Manipulation, Objects and Arrays, Date and Time, Conditional Statements, Switch Case, Looping in JS, Functions.

Module 3: ReactJS

Introduction to ReactJS, Templating using JSX, Components, State and Props, Lifecycle of Components, Rendering List and Portals, Error Handling, Routers, Redux and Redux Saga, Immutable.js, Service Side Rendering, Unit Testing, Webpack.

Module 4: NodeJS

Node js Overview, Basics and Setup, Console, Command Utilities, Modules, Concepts, Events, Node js with Express js, Database Access.

Module 5: MongoDB

SQL and NoSql Concepts, Create and Manage MongoDB, Migration of Data into MongoDB, MongoDB with PHP, MongoDB with NodeJS, Services Offered by MongoDB, Connect MongoDB with Python.

References

1. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer; Chris Northwood- Apress publications.
2. Full Stack Development with MongoDB; Manu Sharma-bpb publications.
3. Modern Full-Stack Development:Using TypeScript, React, Node.js, Webpack, and Docker; Frank W. Zammetti- Apress publications.
4. Mastering Html, Css & Javascript Web Publishing; Laura Lemay, Rafe Colburn, Jennifer Kyrnin- -bpb publications.

Course Title : Predictive Analytics (Elective)
Course Code : ICSC6EA3
Credits : 3
Total Hours : 54

Course Objectives

After completing this class, the student will develop the following competencies.

- Competency in Predictive Analytics Methods.
- Competency in Predictive Analytics Tools.
- Competency in the Predictive Analytics Cycle

Module 1:

Introduction: - Prediction Versus Interpretation, Key Ingredients of Predictive Models, Predictive Modeling Process. Data Pre-processing: - Data Transformations for Individual Predictors- Centering and Scaling, Transformations to Resolve Skewness, Data Transformations for Multiple Predictors- Transformations to Resolve Outliers, Data Reduction and Feature Extraction, Removing Predictors- Predictor Correlations, Adding Predictors, Binning Predictors.

Module 2:

Over-Fitting and Model Tuning-The Problem of Over-Fitting Model Tuning, Data Splitting, Resampling Techniques. Regression Models- Quantitative Measures of Performance, Linear Regression- Partial Least Squares, Penalized Models, Nonlinear Regression Models - Neural Networks, K-Nearest Neighbors.

Module 3:

Forecasting and time series analysis: Introduction to Decision Trees, Chi- Square Automatic Interaction Detectors (CHAID), Classification and Regression Tree (CART), Analysis of Unstructured data, Naive Bayes algorithm. Classification Models: - Introduction of Classification Models - Discriminant Analysis and Other Linear Classification Models - Nonlinear Classification Model -Naïve Bayes - Support Vector Machines.

Module 4:

Introduction to Feature Selection -Consequences of Using Non-informative Predictors, Approaches for Reducing the Number of Predictors-Factors That Can Affect Model Performance-Measurement Error in the Outcome, Measurement Error in the Predictors.

Module 5:

Predicting Cognitive Impairment Predicting Caravan Policy Ownership, The Effect of Class Imbalance- Sampling Methods-Cost-Sensitive Training-Job Scheduling-Case Studies –Real world scenario where forecasting and Time series analysis.

Books of Study

1. Kuhn, Max, Kjell Johnson. “Applied predictive modeling”. Springer, 2018.
2. Montgomery “Applied statistics and probability for engineers” Third edition.

References

1. Siegel, Eric. “Predictive analytics”: The power to predict who will click, buy, lie, or die. John Wiley & Sons, 2013.
2. Abbott, Dean. “Applied predictive analytics”: Principles and techniques for the professional data analyst. John Wiley & Sons, 2014.
3. Miner, Gary, “Practical text mining and statistical analysis for non-structured text data applications”. Academic Press, 2012.

Elective: Bunch B

Course Title : Advanced DBMS (Elective)
Course Code : ICSD8EB1
Credits : 4
Total Hours : 72

Course Objectives

- The design and implement Distributed Databases.
- To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports.
- Learn MongoDB to design queries.

Module 1: Introduction to Database Systems

Introduction to Database Systems and E-R Model : DBMS vs other systems: Overview, A Historical Perspective, Files System vs DBMS, Advantages of DBMS, Describing and storing data in a DBMS, Structure of a DBMS.

Module 2: Structured Query Language and PL/SQL

Creating a table- Displaying table information - Altering an existing table – Dropping, renaming, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, Additional Features of SQL, More SQL - Complex Queries, More Complex SQL Retrieval Queries, Views (Virtual Tables) in SQL: Views-Creation, Renaming the column of a view, Destroys view- Program with SQL, Security-locks, Types of locks, Levels of locks, Cursors - working with cursors, error handling, Developing stored procedures,-Creation, Statement blocks, Conditional execution, Repeated execution, Cursor-based repetition, Handling Error conditions, Implementing triggers, Creating triggers, Multiple trigger interaction.

PL/SQL: Fundamentals - Block structure - comments - Data types – Other data types - Variable declaration - Assignment operation - Bind variables - Substitution variables - Printing, Control Structures and Embedded SQL: Control structures - Nested blocks - SQL in PL/SQL - Data manipulation - Transaction control statements.

Module 3: Transaction Management

Concept of transaction, ACID properties, serializability, states of transaction, Concurrency control, Locking techniques, Time stamp based protocols, Granularity of data items, Deadlock, Failure classifications, storage structure, Recovery & atomicity, Log base recovery, Recovery with concurrent transactions, Database backup & recovery, Remote Backup System, Database security issues.

Module 4: Introduction to NoSQL databases

NoSQL database concepts: Types of data -structured, unstructured, semi structured data, Bigdata, Types of NoSQL databases, NoSQL data modelling, Benefits of NoSQL, Comparison between SQL and NoSQL database systems.
NoSQL using MongoDB: Introduction to MongoDB shell, Running the MongoDB shell, MongoDB client, Basic operations with MongoDb shell, Basic datatypes, Arrays, Embedded documents. Querying with MongoDB: find() function, specifying which keys to return, query criteria, OR queries,

Module 5: Object Oriented Database Management Systems
Object Oriented Database Management Systems (OODBMS) - concepts, need for OODBMS, composite objects, issues in OODBMSs, advantages and disadvantages of OODBMS. Distributed databases - motivation - distributed database concepts, types of distribution, architecture of distributed databases, the design of distributed databases, distributed transactions, commit protocols for distributed databases.

References:

1. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson
2. Abraham Silbersehatz, Henry F. Korth and S.Sudarshan, Database System Concepts, 6 th Edition, Tata McGraw-Hill.
3. 3.James R.Groff and Paul N. Weinberg,The complete reference SQL, 2nd edition,Tata McGraw Hill
4. T. M. Connolly and C. Begg -Database Systems: Practical approach to design, implementation, and management (sixth edition), Publisher: Pearson Education.
5. Vaswani Vikram, Complete Reference: MySQL, McGraw Hill Education.
6. Bayross Ivan, SQL, PL/SQL, The Programming language of ORACLE, BPB Publications, 3rd Rdition.
7. An Introduction to Database Systems, Date, C. J. Pearson Education, New Delhi, 2012.

Course Title : Business Intelligence & Analytics (Elective)
Course Code : ICSD8EB2
Credits : 4
Total Hours : 72

Course Objectives

- To make them aware business analytics foundation.
- To make them ready to apply data analytics skills to the area of business intelligence
- Lean predictive analytics in business intelligence.

Module 1:

Business intelligence: Introduction, Concepts and Applications. Business Intelligence for better decisions, Business Intelligence types, tools, skills, applications. Decision making and Analytics - business intelligence, analytics and decision support. Foundation and technologies for decision making.

Module 2:

Business applications of Decision Trees, Regression, Artificial Neural Networks, Cluster Analysis, Association Rule Mining - Techniques, Algorithm, Exercise, Advantages and Disadvantages.

Module 3:

Big data and future directions for Business Analytics- Big Data Analytics, Business Analytics, Emerging Trends and Future Impacts. Business applications of Big Data, Technologies and Management Big data.

Module 4:

Predictive Analytics: Data mining in Business Intelligence- Text Mining,Web Mining - Business applications, practices and algorithms. Descriptive Analytics - Data warehousing, Business Reporting, Visual Analytics and Business Performance Management.

Module 5:

Understanding BI and Mobility, BI and Cloud Computing, Business Intelligence for ERP Systems, Social CRM and BI

References

1. Business Intelligence and Data Mining, Anil K. Maheshwari, PhD,Business Expert Press, LLC,2015
2. Business Intelligence And Analytics: System For Decision Support, Ramesh Sharda (Oklahoma State University), Dursun Delen(Oklahoma State University),Efraim Turban(University of Hawaii), Pearson Education,Inc., 2015
3. Fundamentals of Business Analytics, 2ed, R N Prasad, Seema Acharya

Elective: Bunch C

Course Title : Image and Video Analytics (Elective)
Course Code : ICSD8EC1
Credits : 4
Total Hours : 72

Course Objectives

- Describe the fundamental principles of image and video analytics and have an idea of their application.
- Able to apply state-of-the-art machine learning techniques (convolutional neural networks) to solving problems in image and video analysis

Module 1:
Introduction to Human visual perception, digital image representation, Image sampling and quantization, Mathematical tools for image processing: Vector and matric operations- Image Transforms (DFT, DCT, DWT, Hadamard).

Module 2:
Image and video segmentation and texture models; -Image and video demonizing- Image and Video enhancement- Image and Video compression. Image Pyramids for analysis and image compression;
Object detection and recognition in image and video- classification models- Object tracking in Video.

Module 3:
Differential Motion Analysis methods, Change detection, Segmentation using motion, Image flow, segmentation using Moving camera, Optical flow, Analysis based on correspondence of interest points, detection of specific motion patterns, video tracking, motion models to aid tracking

Module 4:
Real-time video analytics and video mining, temporal and spatial event recognition, Vision-based activity recognition), Behaviour Analysis, Content-Based Analysis of Digital Video

Module 5:
Video Analytics: state of the art applications with reference to computer vision applications, Deep learning in video analytics, Human motion recognition and its applications, Video Analytics for Business Intelligence, Virtual reality/Augmented reality applications, and Healthcare applications.

References

1. Sonka, Hlavac, Boyle, “Digital Image Processing and Computer Vision”- CENGAGE Learning, Indian Edition
2. Ramesh Jain, Kasturi, Schunck, “Machine Vision”,McGraw-Hill
3. R.C. Gonzalez and R.E. Woods.” Digital Image Processing”, 3rd Edition. Addison Wesley, 2007.
4. White paper: Video Analytics: Technologies and use cases https://wso2.com/whitepapers/innovating-with-video-analytics-technologies-and-use-cases/#07

Course Title : Geospatial Analysis (Elective)
Course Code : ICSD8EC2
Credits : 4
Total Hours : 72

Course Objectives:

By successfully completing the course, students should be able to

- command the theories and methods
- implement and practice typical geospatial methods
- analyze and visualize these implementations
- be familiar with open-source tools and data

Module 1

Introduction and terminology: Spatial analysis, GIS and software tools, Intended audience and scope, Software tools and Companion Materials, Terminology and Abbreviations, Common Measures and Notation. Conceptual Frameworks for Spatial Analysis: Basic Primitives, Spatial Relationships, Spatial Statistics, Spatial Data Infrastructure.

Module 2

Methodological Context: Analytical methodologies, Spatial analysis as a process, Spatial analysis and the PPDAC model, Geospatial analysis and model building, The changing context of GIScience. Building Blocks of Spatial Analysis: Spatial and Spatio-temporal Data Models and Methods, Geometric and Related Operations, Queries, Computations and Density, Distance Operations, Directional Operations, Grid Operations and Map Algebra.

Module 3

Data Exploration and Spatial Statistics, Statistical Methods and Spatial Data, Exploratory Spatial Data Analysis, Grid-based Statistics and Metrics, Point Sets and Distance Statistics, Spatial Autocorrelation, Spatial Regression.

Module 4

Surface and Field Analysis, Modeling Surfaces, Surface Geometry, Visibility, Watersheds and Drainage, Gridding, Interpolation and Contouring, Deterministic Interpolation Methods, Geostatistical Interpolation Methods. Network and Location Analysis, Introduction to Network and Location Analysis, Key Problems in Network and Location Analysis, Network Construction, Optimal Routes and Optimal Tours, Location and Service Area Problems, Arc Routing.

Module 5

Geocomputational methods and modeling: Introduction to Geocomputation, Geosimulation, Artificial Neural Networks (ANN), Genetic Algorithms and Evolutionary Computing, Big Data and Geospatial Analysis, Big Data and Research: Types of Big Data, Challenges of Big Data.

References:

1. Dr Michael J de Smith, Prof Michael F Goodchild, Prof Paul A Longley & Associates, Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools 6th edition, 2018.
2. Hassan Abdishakur, Geospatial Data Science Quick Start Guide, Packt Publishing Limited.
3. Joel Lawhead, Learning Geospatial Analysis with Python: Understand GIS fundamentals and perform remote sensing data analysis using Python 3.7, Packt Publishing Limited, 3rd Edition.

Elective: Bunch D

Course Title : Healthcare Data Analytics (Elective)
Course Code : ICSD9EE1
Credits : 4
Total Hours : 72

Course Objectives

- Explore the various forms of electronic health care information for Analytics.
- To learn and implement various techniques for analyze health care data and to understand the predictive models for clinical data.
- Able to apply analytics for decision making in healthcare services.
- Able to apply data mining to integrate health data from multiple sources and develop efficient clinical decision support systems.

Module 1:
Introduction: Healthcare Data Analytics, Data Sources: Electronic Health Records– Biomedical Image -Sensor Data - Biomedical Signal - Genomic Data - Clinical Text- Mining of Biomedical Literature. EHR-Components of EHR, Benefits and Barrier in EHR, Phenotyping Algorithms.

Module 2:
Analysis: Biomedical Image Analysis- Bio Medical Image -Imaging Modalities-Object Detection-Image segmentation-Image registration – Feature Extraction , Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.

Module 3:
Analytics: Natural Language Processing and Data Mining for Clinical Text: NLP Components-Mining Information fron Clinical Text-Challenges. Mining the Biomedical Literatures- Social Media Analytics for Healthcare.

Module 4:
Advanced Data Analytics: Advanced Data Analytics for Healthcare– Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare-Predictive Models for Integrating Clinical and Genomic Data-Information Retrieval for Healthcare-Privacy-Preserving Data Publishing Methods in Healthcare.

Module 5:
Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.

Applications and Practical Systems for Healthcare: Data Analytics for Pervasive Health, Healthcare Fraud Detection, Data Analytics for Pharmaceutical Discoveries, Clinical Decision Support Systems, Computer-Aided Diagnosis, Mobile Imaging for Biomedical Applications

References

1. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015
2. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.

Course Title : Social Media Analytics (Elective)
Course Code : ICSD9EE2
Credits : 4
Total Hours : 72

Course Objectives

Upon successful completion of this course, students will be able to:

- Describe the different types of data commonly found on social platforms
- Use a social platform API to obtain data and understand the structure of those data
- Visualize that corpus along geographic and temporal axes
- Describe how and why different networks exist within the same data
- Compute a variety of networks measures from a social media dataset
- Describe the various types of text commonly found on social platforms
- Compute sentiment over social text

Module 1:
Introduction-New Challenges for Mining, Graph basics- Graph Representation, Types of Graphs, Connectivity in Graphs, Special Graphs, graph algorithms, Network measures centrality, transitivity and reciprocity, balance and status, similarity, Network Models - Properties of Real-World Networks, Random Graphs, Small-World Model, Preferential Attachment Model

Module 2:

Data Mining Essentials- Data, Data Preprocessing, Data Mining Algorithms, Supervised Learning, Unsupervised Learning.

Module 3:

Communities and Interactions- Community Analysis, Community Evolution, Community Evaluation Information Diffusion in social media- Herd Behavior, Information Cascades, Diffusion of Epidemics.

Module 4:

Influence and Homophily- Measuring Assortativity, Influence, Homophily, Distinguishing Influence and Homophily

Recommendation in social media- Challenges, Classical Recommendation Algorithms, Recommendation Using Social, Evaluating Recommendations

Module 5:

Behavior Analytics- Individual Behavior, Individual Behavior Analysis, Individual Behavior Modelling, Individual Behavior Prediction, Collective Behavior

References

1. Reza Zafarani, Mohammad Ali Abbasi. Huan, "Social Media Mining- An Introduction", Cambridge University Press, 2014.
2. Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, "SMining of Massive Datasets".

Elective: Bunch E

Course Title : Blockchain Technology (Elective)
Course Code : ICSC9EE1
Credits : 4
Total Hours : 72

Course Objectives

- Explain the working of Blockchain Technology.
- Integrating Blockchain technology to real world scenarios
- Ability to understand what and why of Blockchain.
- Explore various components of Blockchain and its use.
- Can create their own Blockchain network application.

Module 1:
Introduction to Block chain Technology, the growth of blockchain technology, Block Chain as a distributed system, the history of blockchain and Bitcoin, Blockchain defined, Generic elements of Blockchain, How Blockchain works, Benefits and limitations of blockchain, Tiers, Feature and Types. consensus mechanism, Type of consensus mechanism, Consensus in blockchain.

Module 2:
Introduction To Cryptocurrency: Bitcoin – Bitcoin Platform, Bitcoin Architectures - Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations. Ethereum concept and Ethereum classic.

Module 3:
Consensus Protocols and Security Issues Trust Essentials: Decentralized Systems, Consensus Protocols: Proof-of-Work (PoW), Proof-of-Stake (PoS), Delegated Proof-of-Stake (DPoS), Proof-of-Burn (PoB), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Proof-of-Activity (PoA), Proof of Elapsed Time (PoET). Blockchain Security Threats, Challenges and Issues.

Module 4:
Enterprise Blockchain Platforms, Enterprise Blockchain Platform: Hyperledger, Hyperledger Architecture, Membership, Blockchain, Transaction, Chaincode, Hyperledger Fabric, Features of Hyperledger, Fabric Demo.

Module 5:
Blockchain Applications: Building on the Blockchain, Smart Contract and Ethereum Platform Introduction Ethereum, Architecture, Smart Contracts, Elements of Smart Contracts, Ethereum Operations, Incentive Model, Transactions in Ethereum, Introduction Solidity

References

1. A. Bahga, V. Madisetti (2017), Blockchain Applications: A Hands-On Approach, VPT.
2. M. Swan (2015), Blockchain: Blueprint for a New Economy, O'Reilly Media.
3. R. Wattenhofer (2016), The Science of the Blockchain, CreateSpace Independent Publishing Platform.
4. I. BASHIR (2017), Mastering blockchain, Packt Publishing Ltd.

Course Title : Big Data Analytics (Elective)
Course Code : ICSC9EE2
Credits : 4
Total Hours : 72

Course Objectives

- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.
- To understand the applications using HDFS and Map Reduce Concepts
- To learn Hadoop ecosystem.

Module 1:
Understanding Big Data-Concepts and Terminologies. Big Data Characteristics-Volume, Velocity, Variety, Veracity, Value. Different types of data-structured, unstructured, semi structured, metadata. Business Motivations and Drivers for Big Data Adoption. Big Data Analytics Life Cycle.

Module 2:
Big Data Processing Concepts-Parallel Data Processing, Distributed Data Processing, Hadoop, Processing Workloads, Cluster, Processing in Batch Mode.
Hadoop Fundamentals-Introduction, Core Components, HDFS Daemons, Map Reduce Daemons, Resource Allocation with YARN, Workflow of MapReduce Job, HDFS High-Availability Daemons, Benefits and Challenges of HDFS.
File Sizes, Block Sizes, and Block Abstraction in HDFS, Data Replication, Data Locality, Network Topology, Network Bandwidth, and Rack Placement Policy

Module 3:
HDFS and MapReduce- Hadoop Distributed File System, MapReduce Framework, Hadoop Cluster Environment.

Map Reduce-Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Module 4:

Hadoop Ecosystem

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Module 5:

Data Analytics Lifecycle. Review of Basic Data Analytic Methods Using R-Introduction to R, Exploratory Data Analysis, Statistical Methods for Evaluation

Advanced Analytics-Technology and Tools: In-Database Analytics-SQL essentials, In-Database Text Analysis, Advanced SQL

References

1. Thomas Erl,Wajid Khattak,Paul Buhler “Big Data Fundamentals: Concepts, Drivers & Techniques”, Prentice Hall.
2. Deepak Vohra, “Practical Hadoop Ecosystem”, Apress.
3. Tom White “Hadoop the Definitive Guide”, O’Reilly.
4. EMC Education Services. “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishing.

MODEL QUESTION PAPERS

Reg. No ..... Name **23U113**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 1 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE - DATA SCIENCE

COURSE : **21UP1CRMCP1 : PROGRAMMING IN C LANGUGAGE**

(For Regular 2023 Admission and Improvement/Supplementary 2022/2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. Analyze the following code segment and determine how many times the loop will be executed:

```
m = 1 ;
do {
    _____
    _____
    m = m + 2;
}while (m < 10);
```

2. Identify the error(s) in the following piece of code, if any:

```
# Include<stdio.h>
main(){
printf ("Welcome to C programming");
};
```

3. Define the concept - NULL pointer.
4. State the significance of the header file `stdio.h`.
5. Mention the limitation of putc() function with respect to other file functions.
6. If a file cannot be opened due to some reasons, it returns a _____ pointer.
7. If a pointer 'ptr' points to a variable 'x', write the statement that would represent the idea.
8. Write the statement to read a string input from keyboard.
9. State the use of `sizeof()` in C.
10. Write a sample structure declaration that would store the details of an employee.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. Considering the following structure declaration, calculate the total memory (in bytes) that would be required by the structure variable:

```
struct book
{
    int book_id;
    char book_name[5];
    float book_price;
}b[2];
```

12. Sometimes, it is required to purposefully exit from a loop. With an example, explain how this can be achieved.
13. Predict the output of the following code when executed:

```
int m[] = {10, 20, 30, 40, 50};
int x, y = 0;
for (x = 0; x < 5; x++)
    y = y + m[x];
printf ("%d", y);
```

14. Predict the output of the following segment of code:

```
# include <stdio.h>
main(){
    int k, num = 30;
    k = (num < 10) ? 100 : 200 ;
    printf ("%d", num);
    return 0;
}
```

15. Differentiate between local and global variables.
16. Explain any one method to detect end-of-file in C.
17. Discuss how branching operation is represented in a flowchart.
18. Describe the limitations of getchar() and scanf() functions for reading strings.

(2 x 6 = 12 Weight)

PART C
Answer any 2

19. Write a program that illustrates how an array is used as a member of a structure.
20. Using recursion, write the code to accept a limit 'n' and display Fibonacci series upto 'n'.
21. Create a C program that uses a user-defined function to find the average of 3 numbers by passing the numbers to the function, and returning the result after calculating the average.
22. Draw a flowchart that prints the following pattern:

```
@
@@
@@@
@@@@
```

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U126**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 1 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE AND DATA SCIENCE

COURSE : **21UP1CRMCP2 : INTRODUCTION TO COMPUTERS**

(For Regular 2023 Admission and Improvement/Supplementary 2022/2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. The standard storage capacity of a floppy disk is _____.
2. Discuss any one drawback of communication satellites.
3. State examples of a search engine.
4. Offering unrealistic amount of money to attract illiterate people and injecting malware is a part of _____ type of crime.
5. Define the term software.
6. _____ uses the phenomenon of total internal reflection for transmitting light signals.
7. State the purpose of FAX modems.
8. State any one limitation of primary memory.
9. Verification of username and password is known as _____.
10. Write short notes on Exploit kits.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. Discuss the various rules for naming files.
12. Explain main memory organization.
13. Discuss in detail about file access methods.
14. Make short notes on INFLIBNET.
15. Discuss the major elements of internet search engines.
16. Compare and make short notes on various classification of software.
17. Make short notes about PUPs.
18. Discuss about any two types of SSDs.

(2 x 6 = 12 Weight)

PART C

Answer any 2

19. Explain the functions of an Operating System.
20. Express your views and summarize the issues related to Net compulsions and cyber-relationship addiction.
21. Discuss in detail about magnetic tapes.
22. Make notes on TCP/IP protocol.

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U143**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 1 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE AND DATA SCIENCE

COURSE : **21UP1CRMCP3 : DATABASE MANAGEMENT SYSTEMS**

(For Regular 2023 Admission and Improvement/Supplementary 2022/2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. Expand the term OLAP.
2. The _____ command is used in SQL to change the structure of a table.
3. Given the following relation, find the degree of the relation:
   INVENTORY (item_no, item_name, item_price, item_doe)
4. Define the term database subschema.
5. State the condition to be satisfied for a relation to be in 1NF.
6. The _____ data type in SQL represents unstructured binary data.
7. Define the term tuple.
8. Write a sample query to view the complete details of table named 'STUDENT'.
9. Define the term domain of an attribute.
10. Define the term instance of a database.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. List all the values that may come in the domain of the attribute 'district' (of Kerala).
12. Discuss briefly about any two date functions in SQL.
13. Discuss the command to create table in SQL along with the specification of key constraints.
14. Differentiate between conceptual and external schema.
15. Explain briefly the natural join operation in relational algebra.
16. Discuss the atomicity issues of file systems.
17. Describe the concept of referential integrity in a relational data model.
18. Differentiate between centralized and distributed databases.

(2 x 6 = 12 Weight)

PART C

Answer any 2

19. Consider the following relational schema and write sample queries for the questions that follow:
    WORKER (worker_id, first_name, last_name, salary, joining_date, department)
    BONUS (worker_ref_id, bonus_date, bonus_amount)
    (i). Display the details of workers who have first name as 'John' and 'Alice'.
    (ii). Display the details of workers who have salary between 10000 and 20000.
    (iii). Display the ID and bonus amount of workers who work in 'Administration' department.
    (iv). Display the average bonus given to the workers.
20. Explain the reasons behind choosing a Database Management System instead of simply storing data in Operating System files. In addition, discuss when would it make sense not to use a Database Management System.

21. Explain about any two relational algebra operations from set theory.
22. Explain briefly about distributed databases.

(5 x 2 = 10 Weight)

Reg. No ..... Name **23157**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 1 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE AND DATA SCIENCE

COURSE : **21UP1CPCMT3 : MATHEMATICS - 1**

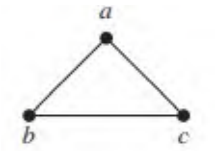
(For Regular 2023 Admission and Improvement / Supplementary -2022/2021 Admissions)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. Draw all the spanning trees of the given simple graph.



2. Define Pseudographs.
3. Explain graphical method of solving an LP Problem.
4. The standard weight of a special purpose brick is 5 kg and it contains two basic ingredients B_1 and B_2. B_1 costs Rs.5 per kgand B_2 costs Rs.8 per kg. Strength considerations dictate that the brick should contain not more than 4 kg of B_1 and a minimum of 2 kg of B_2. The demand for the product is likely to be related to the price of the brick. Give linear programming model for the above problem to find the minimum cost of the brick.
5. When will we say that a transportation problem is balanced.
6. Define Huffman-coding algorithm.
7. Define multigraph with an example.
8. Draw the graph represented by the given adjacency matrix.

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 0 & 0 \\ 0 & 2 & 2 \end{bmatrix}$$

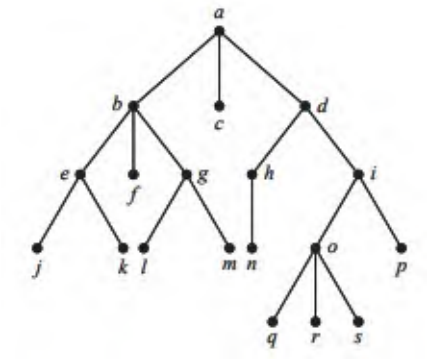
9. Define rim conditions in transportation problem.
10. Define left child and right child of a binary tree with example.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11.



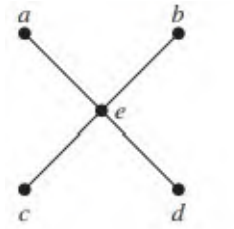
Answer these questions about the above rooted tree.
a) Which vertex is the root?
b) Which vertices are internal?
c) Which vertices are leaves?
d) Which vertices are children of j?
e) Which vertex is the parent of h?
f) Which vertices are siblings of o?
g) Which vertices are ancestors of m?
h) Which vertices are descendants of b?

12. A company has factories at F_1, F_2, and F_3 which supply to warehouses at W_1, W_2 and W_3. Weekly factory capacities are 200, 160 and 90 units, respectively. Weekly warehouse requirement are 180, 120 and 150 units,respectively. Unit shipping cost (in rupees)are as follows:

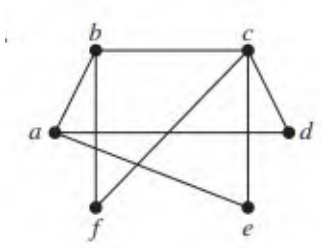
	W_1	W_2	W_3	Supply
F_1	16	20	12	200
F_2	14	8	18	160
F_3	26	24	16	90
Demand	180	120	150	450

Use Vogel's Approximation Method to find an initial feasible solution to given transportation problem.

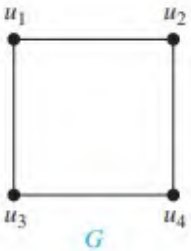
13. Determine whether these graphs are bipartite.If not, give reason.
a)

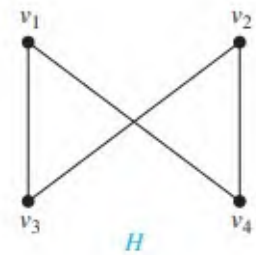


b)

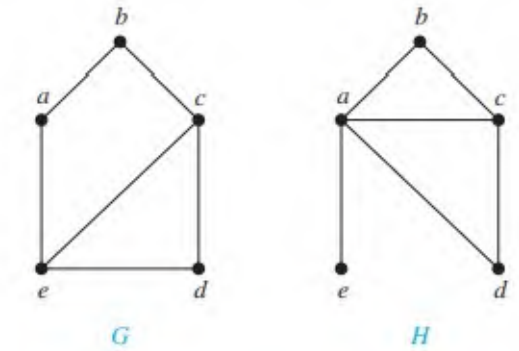


14. Prove that a full m-ary tree with i internal vertices contain *n = mi+1* vertices.
15. Expalin the procedures of preorder traversal,inorder traversal and postorder traversal.
16. Solve the following Linear programming problem graphically;
minimize: $z = 3x_1 + 2x_2$
subject to: $5x_1 + x_2 \geq 10$
$x_1 + x_2 \geq 6$
$x_1 + 4x_2 \geq 12$
$x_1 , x_2 \geq 0$
17. Check whether the following graphs are isomorphic or not.If not give reason
1)





2)



18. Define n-Cubes and draw the following;
a) Q_1 b) Q_2 c) Q_3

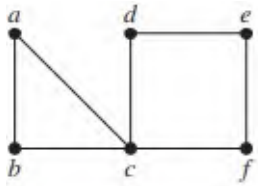
(2 x 6 = 12 weight)

PART C

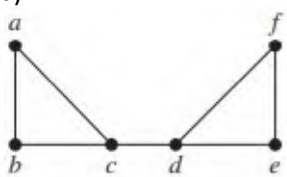
Answer any 2

19. (i) Show that in every simple graph there is a path from any vertex of odd degree. (ii)Find all cut vertices and cut edges of the given graphs.

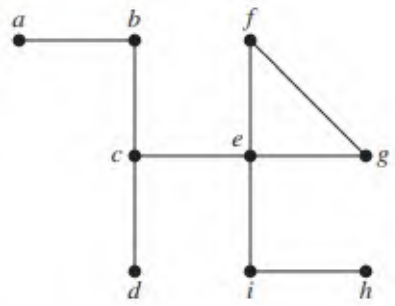
a)



b)



c)



20. Represent the expressions (x + xy) + (x/y) and x + ((xy + x)/y) using binary trees.
also write these expressions in
a) prefix notation.
b) postfix notation.
c) infix notation.

21. A department has five employees with five jobs to be performed. The time (in hours) each men will take to perform each job is given below;

		Employees				
		1	**2**	**3**	**4**	**5**
Jobs	**A**	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated, one per employee, so as to minimize the total man-hours?

22. Solve the following Linear programming problem using simplex method;
maximize: $z = 16x_1 + 17x_2 + 10x_3$
subject to: $x_1 + x_2 + 4x_3 \leq 2000$
$2x_1 + x_2 + x_3 \leq 3600$
$x_1 + 2x_2 + 2x_3 \leq 2400$
$x_1 \leq 30$
$x_1, x_2, x_3 \geq 0$

(5 x 2 = 10 weight)

Reg. No…….. Name…… **22UP211**

END SEMESTER EXAMINATION – MARCH 2022

SEMESTER –1: INTEGRATED M SC IN COMPUTER SCIENCE - DATA SCIENCE

COURSE: 21UP2CCMAL01 - കഥ, കവിത, ആത്മകഥ

(For Regular - 2021 admission)

Time: Three Hours Max. Weightage: 30

PART A

Answer any 8 questions

1. വള്ളത്തോളിന്റെ പ്രസിദ്ധമായ മഹാകാവ്യമേതാണ്?
2. "കെട്ടിച്ചുവിട്ടാൽ പിന്നെ,
   കെട്ടിയോന്റെ വീടാണ് വീട്
   കെട്ടിയോൻ ചത്താൽ പിന്നെ,
   ചെന്നവീടുമില്ല ഇറങ്ങിയ വീടുമില്ല"- വരികളുടെ സാമൂഹിക പ്രസക്തി വ്യക്തമാക്കുക
3. സുഭദ്രയുടെ പ്രണയത്തോട് വീട്ടുകാർ എങ്ങനെയാണ് പ്രതികരിച്ചത്?
4. പോസ്റ്റ്മാൻ എന്ന കഥ ആത്യന്തികമായി പറയാൻ ശ്രമിയ്ക്കുന്നത് എന്താണ്
5. പി. കുഞ്ഞിരാമൻ നായരുടെ ആത്മകഥ?
6. "നാടകമേയുലകം നാളെ നടപ്പതേയാരറിവർ" ഈ വരികൾ ഏതു കവിതയിൽ, ആര് പറയുന്നത്?
7. ആരാണ് മെക്കാളേയുടെ മകൾ?
8. എൻ.എസ്. മാധവൻ എഴുതിയ മറ്റൊരു കഥയുടെ പേരെഴുതൂ
9. മഞ്ഞമുത്തി ഏത് കഥയിലെ കഥാപാത്രമാണ്?
10. മരപ്പാവകൾ എന്ന ശീർഷകം കഥയ്ക്ക് എത്രമാത്രം അനുയോജ്യമാണ്?

(1 x 8 = 8 weight))

PART B

Answer any 6 questions

11. 'അമ്മയെ കുളിപ്പിക്കുമ്പോൾ' എന്ന കവിതയ്ക്ക് ആസ്വാദനം തയാറാക്കുക
12. "ബഷീറിന്റെ ജീവിതം തന്നെയാണ് അദ്ദേഹത്തിന്റെ സാഹിത്യം". ജന്മദിനം എന്ന കഥയുമായി ബന്ധപ്പെടുത്തി ഈ പ്രസ്താവനയെ വിലയിരുത്തുക
13. കടൽ എന്ന ചെറുകഥയിലെ അച്ഛനും അമ്മയും തമ്മിലുള്ള ബന്ധം തകർന്നത് എങ്ങനെ? വിശദീകരിയ്ക്കൂ
14. വള്ളത്തോൾ ഗാന്ധിയെ ആദർശവത്കരിയ്ക്കുന്നത് എങ്ങനെയെല്ലാമാണ്?
15. ലൂസിയുടെ പ്രശ്നങ്ങൾ ഗീവർഗ്ഗീസച്ഛൻ പരിഹരിയ്ക്കുന്നത് ശരിയായ വഴിയിലൂടെയാണോ? നിങ്ങളുടെ അഭിപ്രായം രേഖപ്പെടുത്തുക.
16. രാമച്ചി മുന്നോട്ടു വെക്കുന്ന ആദിവാസി പ്രശ്നം എത്രമാത്രം കഥയിലൂടെ വിനിമയം ചെയ്യപ്പെട്ടു? കാരണസഹിതം വ്യക്തമാക്കുക.
17. ഇംഗ്ലീഷ് ഭാഷയുടെ അധിനിവേശത്തെ കവി വിമർശിയ്ക്കുന്നത് എങ്ങനെയെല്ലാം?
18. ഗോപികയുടെ വാക്കുകൾക്ക് പിന്നിൽ ഒളിഞ്ഞു കിടക്കുന്ന സ്ത്രീജീവിതം എന്താണ്?

(2 x 6 = 12 weight)

PART C

Answer any 2 questions

19. മരപ്പാവകൾ എന്ന കഥയിലെ നളിനിയിലൂടെ സ്ത്രീയുടെ സാമൂഹിക പ്രശ്നങ്ങൾ കാരൂർ അവതരിപ്പിക്കുന്നത് എങ്ങനെയെല്ലാമാണ്?
20. കാലം മാറുമ്പോൾ കൂടെ മാറാൻ കഴിയണമെന്ന ആഹ്വാനമാണ് വൈലോപ്പിള്ളിക്കവിതകളുടെ മുഖമുദ്ര. യുഗപരിവർത്തനത്തെ മുൻനിർത്തി വിശകലനം ചെയ്യുക
21. 'മലയാളസാഹിത്യത്തിലെ പരിസ്ഥിതി ദർശനങ്ങൾ' പഠിക്കാനുള്ള രചനകളെ ആധാരമാക്കി വിശദീകരിയ്ക്കുക.
22. "മരപ്പാവകൾ, ഹിഗ്വിറ്റ, കടൽ എന്നീ രചനകളിലെ സ്ത്രീയവസ്ഥകൾ സാമൂഹികമായ പ്രതിനിധാനങ്ങളാണ്." ഈ അഭിപ്രായത്തോടുള്ളനിങ്ങളുടെ പ്രതികരണം ഉദാഹരണസഹിതം രേഖപ്പെടുത്തുക.

(5 x 2 = 10 weight)

****

Reg. No ..... Name **24U213**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 2 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP2CRMCP04 - OBJECT ORIENTED PROGRAMMING USING C++**

(For Regular - 2023 Admission and Improvement / Supplementary - 2022/2021 Admissions)

Time : Three Hours Max.Weightage : 30

PART A

Answer any 8 Questions

1. State any two programming languages that supports structured programming.
2. Give an example of an exit-controlled loop.
3. Identify the error in the following code segment:

```
class Room{
   int width, height;
   void setValue (int w, int h){
      width = w; height = h; }
};
main(){
   Room obj;
   obj.width = 20;
}
```

4. Predict the output of the following code:

```
class Sample{
   int var;
   public: Sample(){  var = 10;  }
           friend void fun();
};
void fun(){
   Sample S;
   cout << S.var << endl;
}
main(){
   fun();
}
```

5. A destructor is represented by ---------- symbol.
6. Define the term constructor in C++.
7. List any two operators that can be overloaded.
8. If A, B and C are three classes such that C inherits A and B, then write the syntax of inheriting it.
9. Identify errors in the following code fragment:

```
class F {
  int g;
  public : void readit () { cin >> g; }
};
class G : public F {
  public: void test () { g -- ; }
};
```

10. Runtime polymorphism can be implemented in C++ by using ----------.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Discuss the need of preprocessor directive `#include<iostream>`.
12. Using recursive functions, write a C++ program to find factorial of a number.
13. Define static member functions. Discuss its properties.
14. Define friend functions. List the properties of a friend function.
15. Discuss the features of constructors.
16. Predict the output of the following program:

```
class Counter{
   int count;
   public: Counter () { count = 0; }
           void inc_Count() { count++;}
           int get_count() {return count;}
};
void main() {
   Counter C1,C2;
   cout<<"\tC1="<<C1.get_count();
   cout<<"\tC2="<<C2.get_count();
   C1.inc_count();
   C2.inc_count();
   C2.inc_count();
   cout<<"\tC1="<<C1.get_count();
   cout<<"\tC2="<<C2.get_count();
}
```

17. Explain multiple inheritance. Discuss the issues of multiple inheritance.
18. State the rules for defining virtual functions.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Explain the various programming paradigms.
20. Write a C++ program to show how friend functions can be used with classes.
21. Write a program that implements overloading of any binary operator.
22. Write a program to show how pointers are used with derived class objects.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U224**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 2 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP2CRMCP05: DATA STRUCTURE USING C++**

(For Regular - 2023 Admission and Improvement / Supplementary – 2022/2021 Admissions)

Time : Three Hours Max.Weightage: 30

PART A

Answer any 8 Questions

1. Define the data type - `enum`.
2. _____ is a pointer to the initial location of the array.
3. Define the average case complexity of bubble sort algorithm.
4. Define the complexity of binary search algorithm.
5. Consider the expression P: 12, 7, 3, -, /, 2, 1, 5, +, *, +. Find the value of the expression P, by inspection by hand.
6. Define the data structure - stack.
7. With the queue pointers - front and rear, write the situation for an underflow.
8. List any two disadvantages of a linked list.
9. The _____ node points to the first node in the linked list.
10. The time complexity for inserting into a singly-linked list is _____.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Memory for various program elements can be allocated during compile-time or at runtime. With an example, explain how both these methods differ.
12. A 2D array is defined as [0..7, 2..3] requires 2 bytes of storage space for each element. If the array is stored in row-major form, then calculate the address of element at location [6,2]. Given that the base address of the array is 100.
13. If the follwing numbers are stored in an array, illustrate how bubble sort works on each iteration:
    32, 51, 27, 85, 66, 23, 13, 57
14. Write the algorithm to remove an element from a queue.
15. Discuss the operations that can be performed on a stack.
16. Discuss the situation when underflow occurs in a stack.
17. Write the algorithm to insert a new node at the beginning of a linked list.
18. Give a brief idea about doubly linked list.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Write an algorithm that uses divide-and-conquer approach to sort an array. Implement the same in C++.
20. Write a C++ program to implement a queue using array. Use ordinary functions to implement the functionalities to create a queue, insert into it and display the queue.

21. Write a C++ program to create a stack using array. Use ordinary functions to implement functionalities to create the stack, delete an element from the stack, and to traverse it.
22. Write an algorithm to create a doubly linked list and traverse the list.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U243**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 2: INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP2CRMCP06 - OPERATING SYSTEMS**

(For Regular - 2023 Admission and Improvement / Supplementary - 2022/2021 Admissions)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8 Questions

1. Expand the term API.
2. State an example of a non-preemptive CPU scheduling algorithm.
3. State the drawback of SJF algorithm.
4. Concurrent access to shared data may result in data ----------.
5. A deadlocked system is in a ---------- state.
6. The ---------- semaphores are also known as mutex locks.
7. State the need of base register.
8. Define fifty-percent rule in fragmentation.
9. State the data structures needed to implement LRU page replacement algorithm.
10. Disks provide the bulk of secondary storage on which a file system is maintained. Mention a characteristic that make them a convenient medium for storing multple files.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Write short notes on caching.
12. List the various sections of a process.
13. Differentiate between preemptive and non-preemptive scheduling.
14. Write short notes on any one synchronization tool.
15. Discuss how it can be ensured that deadlocks never occur in the system.
16. Discuss the solutions to various types of fragmentation.
17. Discuss address binding in brief.
18. List and explain the various attributes of a file.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Write short notes on Batch Operating Systems and Multiprogramming Operating Systems.
20. Examine Round-Robin scheduling in detail.
21. Examine the conditions that may ensure that deadlock can be prevented.
22. Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

Construct the physical memory with the above data mapped to it. Calculate the physical addresses for the following logical addresses:
(a). 0, 430 (b). 3, 400

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U258**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 2 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP2CPCMT02 - MATHEMATICS - II - LINEAR ALGEBRA**

(For Regular - 2023 Admission and Improvement / Supplementary - 2022/2021 Admissions)

Time : Three Hours Max. Weightage : 30

PART A

Answer any 8 Questions

1. (-1)v = -v for every v ∈ V
2. Define Basis of a vector space and give the standard basis for F^2,P^2 and F^3
3. Check the list (2,3,1) , (1,-1,2) , (7,3,8) are linearly independent or not in F^3;
4. Define Linear Function with an Example.
5. Find the transpose of the following matrices;

$$\begin{pmatrix} 2 & 5 & 3 \\ 1 & 8 & 0 \end{pmatrix}, \begin{pmatrix} a & c \\ d & c \\ b & b \end{pmatrix}, \begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \begin{pmatrix} 2 & 3 & 4 & 6 & 5 \\ 1 & 3 & 5 & 0 & 1 \end{pmatrix}$$

6. Explain diagonal of a matrix and upper triangular matrix with suitable example.
7. Define Invariant subspace.Suppose T ∈ L(V) .Show that each of the following subspaces of V is invarient under T;

    1. {0}
    2. V
    3. NullT
    4. RangeT

8. prove the following result;
   < u, λv > = $\bar{\lambda}$ < u,v > for all λ ∈F and u,v ∈ V
9. Define innerproduct space
10. Prove the following result;

    1. For each fixed u ∈V, the function that takes V to < v,u > is a linear map from V to F
    2. < 0,u> = 0 for every u ∈ V

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Prove that a subset U of V is a subspace of V if and only if U satisfies the following three conditions:

    1. 0 ∈ U
    2. u,w ∈ U implies u+w ∈ U
    3. a ∈ F and u ∈ U implies au ∈ U

12. Check whether the list of vectors (1,1),(1,-1) is basis in F^2

13. Suppose $D \in L(P(R),P(R))$ is the differentiation map defined by $D_p = p'$ and $T \in L(P(R),P(R))$ is the multiplication by x^2 defined by $T_p(x) = x^2p(x)$.Then prove that multiplication on linear map is not commutative.
14. show that the following maps are linear;

    1. T: V→W defined by T(v)=0
    2. D: P(R)→P(R) defined by $D_p=p'$
    3. T: P(R)→P(R) defined by $T_p= \int_0^1 P(x)\,dx$
    4. T: P(R)→P(R) defined by $T_p(x) = x^2\,p(x)$
    5. T: R^3→R^2 defined by T(x,y,z) = (2x-y+3z, 7x+5y-6z)

15. Check whether $T \in L(P^2)$ defined by $T(at^2+bt+c) = (5a+b+2c)t^2 + 3bt +(2a+b+5c)$ is diagonalizable with respect to the basis t^2-2t,-2t+1,t^2+1 of P^2.Give valuable reason for your answer.
16. Give matrix representarion for the following operators

    1. $T \in L(F^3)$ defined by T(x,y,z) = (2x+y, 5y+3z, 8z)
    2. $T \in L(F^2)$ defined by T(x,y) = (2x+3y, 5x)

17. State and prove Pythegorean theorem.
18. Check the standard basis in F^3 is an orthonormal list.

(2 x 6 = 12 Weight)

PART C
Answer any 2 Questions

19. The span of list of vectors in V is the smallest subspace of V containing all the vectors in the list.
20. Prove the following;

    1. Let $T \in L(V,W)$ .Then T is injective if and only if NullT ={0}
    2. If $T \in L(V,W)$ then range T is a subspace of W.

21. Suppose $T \in L(V)$ and $v_1,.....,v_n$ is a basis of V. Then the following are equivalent:
    a) The matrix T with respect to $v_1,.....,v_n$ is upper triangular
    b) $Tv_j \in$ span $(v_1,.....,v_n)$ for each j=1,2,....n.
    c) span $(v_1,.....,v_n)$ is invariant under T for each j=1,2,....n.
22. State and prove Triangle inequality and Parallelogram Inequality.

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U306**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 3 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE - DATA SCIENCE

COURSE : **21UP3CRMCP7 : INTRODUCTION TO DATA SCIENCE**

(For Regular 2022 Admission and Improvement/Supplementary 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8 questions

1. List any two statistical methods in python that can be applied to a dataset in data exploration.
2. Mention a real-world example of a population and its sample.
3. List any two examples of optimization algorithms.
4. Data Science evolved initially with the idea of mapping _____ with computer science.
5. List any two cases where a heatmap can be employed to visualize data.
6. List any two metrics that are used in calculating the accuracy of a recommendation system.
7. State an advantage of incorporating data science technology in government sector.
8. Mention an example of a system that employs SVD in its datasets.
9. Define sanity checking in exploration of data.
10. State the main challenge in using a machine learning algorithm.

(1 x 8 = 8 Weight)

PART B

Answer any 6 questions

11. Discuss the role of a data scientist in the data science process.
12. Many statisticians and researchers have made remarkable contributions in the evolution of data science. Discuss the contributions made by John Tukey.
13. Using a bipartite graph, explain how a real world recommendation engine works.
14. Differentiate between Decision Tree and Random Forest algorithms.
15. Define the concept – fitting a model. Also, state when does a model overfit.
16. With the following data, calculate the median and mode:

S	L
0	7 8
1	3 3 5 7
2	2 4 5 7 8
3	2 2 2 6
4	3

17. Discuss the various categories of data visualization.
18. Discuss the benefits and drawbacks of Random Forest algorithm.

(2 x 6 = 12 Weight)

PART C
Answer any 2 questions

19. Using a suitable statistical method, test whether the variables Educational Qualification and Marital Status are related to each other, based on the following data:

Qualification Marital Status	Middle School	High School	Bachelor's	Master's	Ph.D.	Total
Never Married	18	36	21	9	6	90
Married	12	36	45	36	21	150
Divorced	6	9	9	3	3	30
Widowed	3	9	9	6	3	30
Total	39	90	84	54	33	300

20. Make a detailed note on the tools used for exploratory data analysis with bivariate data.

21. Given below is the sample representing the relationship between GDP and vehicle sale in each year. Predict the sales in 2017 if the GDP rate was 8.12. Also, calculate the accuracy of the model.

Year	2011	2012	2013	2014	2015	2016
GDP	6.2	6.5	5.48	6.54	7.18	7.93
Vehicle Sales (in lakhs)	26.3	26.65	25.03	26.01	27.9	30.47

22. Decompose the representative matrix $\begin{bmatrix} -4 & -7 \\ 1 & 4 \end{bmatrix}$ into product of three matrices.

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U318**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 3 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE - DATA SCIENCE

COURSE : **21UP3CRMCP8 : PROGRAMMING IN PYTHON**

(For Regular - 2022 Admission and Improvement/Supplementary - 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. Let the variable x be "dog" and the variable y be "cat". Write the values returned by the following operations:
```
print (x + y)
print( "the " + y + " chases the " + x)
```
2. Array creation in python is based on the object called _____.
3. Write an example of a lambda function in python.
4. Define the term operator.
5. State the main drawback of executing a script from the IDLE window.
6. Give an example for an exception.
7. Write the statement that prints the first 10 rows of a dataset.
8. Write a statement that prints a string from its fifth position onwards.
9. The term _____ refers to the rules for forming sentences in a language.
10. Predict the output of the following code:
```
list=['abcd',786,2.23,'Tom',70.2]
print(list[-2])
```

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. Define tuple in python. Explain how tuples are created.
12. Differentiate between `loc` and `iloc` parameters in a dataframe.
13. Explain `arange()` function with an example.
14. Write a python program that displays your name, address, and telephone number.
15. Discuss the use of `clear()` in sets. Also, explain how it differs from `del` keyword.
16. With a program, explain `nested if` statement.
17. Explain how exceptions are handled with try-except block.
18. Discuss the use of an else block in exception handling.

(2 x 6 = 12 Weight)

PART C

Answer any 2

19. With an example, explain how constructors are used in derived classes.
20. Write a program that prints prime numbers within a range.
21. Create a CSV file to store the details of 10 students with columns - RollNo, Name, Marks. Create a bar plot and a scatter plot in a single frame, plotting the relationship between name and marks.
22. Write a program to multiply two matrices using numpy library.

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U336**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 3 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE - DATA SCIENCE

COURSE : **21UP3CRMCP9 : R PROGRAMMING AND MATHEMATICS FOR ARTIFICIAL INTELLIGENCE**

(For Regular 2022 Admission and Improvement/Supplementary 2021 Admission)

Time : Three Hours Max. Weightage : 30

PART A

Answer any 8

1. Expand PCA.
2. Mention the library used to find the power of a matrix and its associated function
3. State the duality law
4. Define logical equivalence with an example
5. Mention the scalar types in R
6. Describe functions in R with an example
7. List the common probability distributions used in R
8. Define a scalar
9. Describe the purpose of venn diagrams
10. Define row reduced echelon form of a matrix

(1 x 8 = 8 weight)

PART B

Answer any 6

11. Briefly explain the principle behind dimensionality reduction in PCA
12. Explain the terms used in SVM
13. Explain the importance of eigen value.
14. Explain briefly coercion and combine functions in R
15. Brief on first order logic
16. Write a program in R to find the factors of a number using for loop
17. Brief on how to select the best machine learning models from the existing models.
18. Differentiate between cbind() and rbind()

(2 x 6 = 12 weight)

PART C

Answer any 2

19. Explain data frame operations with the help of an example
20. Explain the concept of matrices, determinants and its inverse in detail
21. Explain in detail the miscellaneous operators in R
22. Explain the concept of logical equivalences using idempotent law, commutative law, absorption law.

(5 x 2 = 10 weight)

Reg. No ..... Name **23U352**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 3 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP3CRMCP10 : COMPUTER ORGANIZATION AND ARCHITECTURE**

(For Regular 2022 Admission and Improvement/Supplementary 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. The number of bits in the control word of a CPU architecture with seven general purpose registers is _____.
2. Write the formula to calculate the effective address of an operand.
3. In 2's complement system, the leftmost bit is _____ for negative numbers.
4. List any two examples of cache coherence protocols.
5. If a RAM is of size 128 x 8, calculate the number of bits required as the address bits.
6. The ---------- register points to the top of the stack.
7. State the main advantage of having a modular memory.
8. Define Gray code in number system.
9. In a 16-bit address bus, the --------- bit position indicates the selection of RAM or ROM.
10. The typical access time ratio between cache and main memory is in the range _____.

(1 x 8 = 8 weight)

PART B

Answer any 6

11. With a diagram, explain how memory is connected to CPU.
12. Write short notes on multiprogramming.
13. Consider the expression X = (AB + CD)/E. Write the instructions that evaluates the expression in two-address form.
14. Write brief notes on hypercube connection.
15. List the steps involved in the instruction cycle of an instruction pipeline.
16. With an example, differentiate between register notation and assembly language notation of machine instructions.
17. A computer must have instructions capable of performing four types of operations. List the operations.
18. Multiprocessing can improve performance by decomposing a program into parallel executable tasks. Discuss how this can be acheived.

(2 x 6 = 12 Weight)

PART C
Answer any 2

19. Make short notes on RISC instructions. Write the RISC instructions for the following expression:
    X = (P / Q) x (Q -R)
20. Implement the logic function F = (XZ + Y'Z + X'YZ)' using universal gates alone.
21. Discuss how straight-line sequencing and branching are performed by the CPU.
22. With an example of page replacement, explain the LRU algorithm.

(5 x 2 = 10 weight)

Reg. No ..... Name **23U368**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 3 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP3CPSTA01 :PROBABILITY AND STATISTICS**

(For Regular 2022 Admission and Improvement / Supplementary 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. What is the correlaton coefficient between the pairs of points (2,5) and (3,1)?
2. The mean mark of 100 students was found to be 50.
   Later on it was found out that a score of 87 was misread as 78.
   Find the correct mean
3. Give axiomatic definition of probability
4. The mean weight of 150 students (both boys and girls)in a class is 60 kg. The mean weight of boys is 70kg. and the girls is 55kg. Find the number of boys and girls?
5. Define classification and tabulation of data?
6. Define frequency density of a class
7. Define marginal distributions
8. Distinguish between census and sampling
9. Find k, if f(x,y) = k, 0<x<1, 0<y<1 is a joint probability density funtion.
10. Find the A.M. and S.D. of the natural numbers from 1 to 11.

(1 x 8 = 8 weight)

PART B

Answer any 6

11. Show that correlation coefficient is invariant under linear transformation
12. Define mathematical expectation? State its properties?
13. Find the coefficient of correlation if the regression equations are 3x+11y-7=0 and 3y+8x+16=0
14. There are two options in a game. If the player wins (1) he will get Rs.200 with probability 0.7 and Rs.500 with probability 0.3, (2) he will get an assured amount Rs.300. Which option is beneficial for the player?
15. Define simple random sampling. Distinguish between simple random sampling with and without replacement.
16. Briefly explain different types of scaling techniques.
17. The mean of a distribution is 15 and variance is 25. Also given that $\beta_1 = 1$. Find the third moment about origin ?
18. Show that the arithmetic mean is never less than and the geometric mean, again geometric mean is never less than the harmonic mean

(2 x 6 = 12 weight)

PART C
Answer any 2

19. (a) Explain Skewness? How is it measured? (b) calculate the Karl Pearson's coefficient of skewness from the following data

class	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No.	6	12	22	48	56	32	18	6

20. Explain the concept of regression. Obtain the regression equation of Y on X

Y :	9	8	10	12	11	13	14	16	15
X :	1	2	3	4	5	6	7	8	9

21. What are the different methods for collection of primary data?

22. A continuous random variable X has the following density function,
$f(x) = ax, \quad 0 \le x \le 1$
$= a, \quad 1 \le x \le 2$,
$= -ax + 3a, \quad 2 \le x \le 3$
$= 0$ elsewhere
(1) Determine the constant a (2) obtain the distribution function
(3) sketch the graphs of f(x) and F(x)

(5 x 2 = 10 weight)

Reg. No ..... Name **23U102**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 1 : ENGLISH (COMMON COURSE FOR INTEGRATED M Sc. PROGRAMME COMPUTER SCIENCE - DATA SCIENCE)

COURSE : **19UP1CCENG1 : COMMUNICATION SKILLS IN ENGLISH**

(For Regular 2023 Admission and Improvement/Supplementary 2022/2021 Admissions)

Time : Three Hours **Max. Weightage : 30**

PART A

Answer any 8

1. If I had found her address_____(Complete the conditional by using an appropriate clause)
2. He is _____ very strange man. He has _____ queer habit of sleeping during _____ the day and remaining awake at _____ night. (Insert articles)
3. Sir, I feel that I am the ideal candidate for the receptionist's position in your company because I have three years of experience as a receptionist in a company that is similar to yours. My phone skills and written communication are excellent. These skills, and others that I have learned on the job, helps me understand that every person in a company helps make the business a success. At my current job, the team always say that I am very helpful. Everyone appreciate when I go the extra mile to get the job done right. My co-workers as well as the current employer feels that I am an asset to the team. (Rewrite the sentence by ensuring subject verb agreement)
4. He is very wealthy. He is not happy. (Combine the sentence by uisng the appropriate conjunction)
5. They finished all their homework before they started to watch television, **------?** (Use the appropriate question tag)
6. He walked along the road, wondering what (happen) and where all the people (go). The streets (be) deserted, and the stalls (leave) as they were, with fruit and vegetables arranged in neat rows. (Use the correct form of the tense)
7. The waiters of that famous restaurant had served the customers poorly. (Change the voice)
8. Who was the last to leave the office? (Change it into an embedded question)
9. Suddenly she came upon a little three-legged table, all made _____ solid glass; there was nothing in it except a tiny golden key, and Alice's first thought was that it might belong _____ one of the doors of the hall; but, alas! either the locks were too large, or the key was too small, but _____ any rate it would not open any of them. However, on the second time round, she came upon a low curtain she had not noticed before, and behind it was a little door about fifteen inches high: she tried the little golden key in the lock, and _____ her great delight it fitted! (Fill in the blanks with appropriate prespositions)
10. The lady is my aunt. She is wearing a green dress. (Combine the sentences by using an appropritate relative pronoun)

(1 x 8 = 8 Weight)

PART B

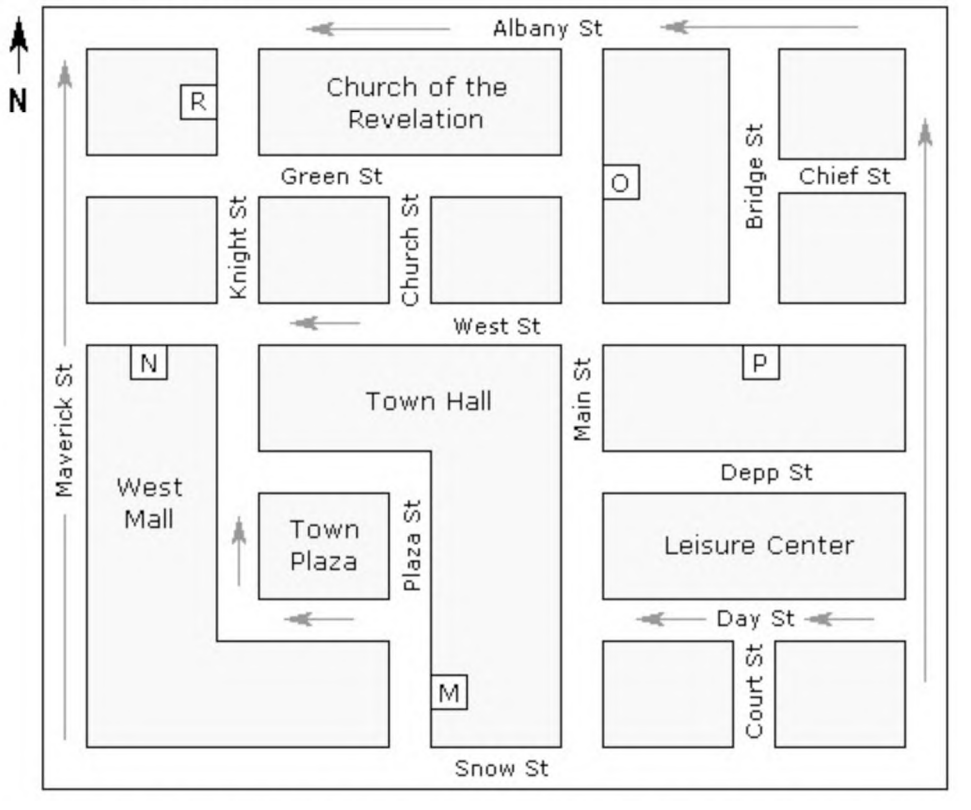
Answer any 6

11. Use the given clues to instruct your friend over phone to install a newly bought surveillance camera in front of his house. Use additional details if necessary.
Unboxing the camera - assembling them together - inserting the memory card - drilling the wall - mounting the camera - power cable - powerbutton - LED indicator.

12. Mark the appropriate tone for the follwing sentences:
You understand your role, don't you? [clarification]
We aren't expected to finish the report by Friday, are we? [clarification]
I've been playing the violin for seven years.
Are you going to the college tomorrow?
I am sorry.

13. Imagine you are receiving a phone call from the Minister of Education to ask your opinion about introducing a system of having three days online and two days offline classes per week for colleges in the state. Write a conversation comprising at least eight to ten pairs of exchanges between you and the Minister.

14. You are at the Liesure Centre. A stranger approaches you to ask you directions to go to the Church of the Revelation. He said he wants to visit a mall on his way to do some shopping. Give him directions.



15. Talk to your doctor over phone about the backache that has been troubling you for a while. Explain to him the nature of your pain and enquire about a convenient time for a visit. The conversation should ideally have at least four to six pairs of exchanges.

16. Following the IRSF pattern, rearrange the sentences below:
Sruthi: Is your government doing anything to provide employment?
Sukhvinder: It tries to help small businesses with tax breaks, but it could do a lot more. What's the situation in Kerala?
Sukhvinder: Yes, it's getting worse. But I think it's a problem in most places, isn't it?
Sruthi: Why? Is unemployment a big problem in Punjab?
Sukhvinder: Actually, no… I am now worried whether I will have my job next month.
Sruthi: Hello, Sukhvinder. It is a long time. How are you?
Sukhvinder: Well, it is an issue, but it's not as bad as a few years ago.
Sruthi: Alcohol causes a lot of problems there. Is it the same in Punjab?
Sukhvinder: I am fine. How are you?
Sruthi: I am good. Hope you got the promotion you were waiting for.

17. Strike a conversation with your hair stylist. Ask him to do a formal hairdo as you are going to appear for a job interview the next day. Follow the IRSF pattern in the conversation that should ideally have at least four to six pairs of exchanges.

18. You are looking forward to buying a used car and you find the following advertisement in a newspaper. Make a call to the seller. Your conversation should have at least four to six exchanges.
Suzuki Swift (Diesel) available for sale, 2014 model. Interested buyers may contact: 940000000

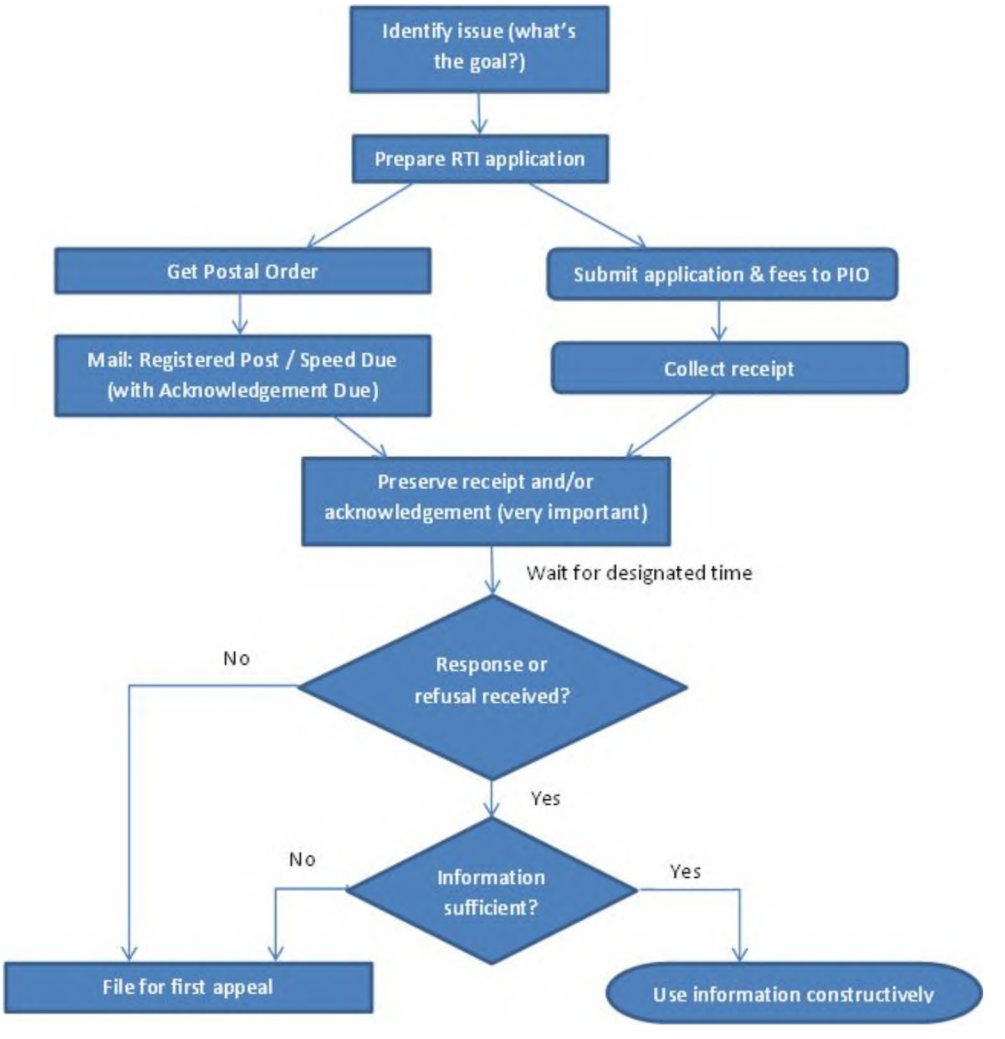
(2 x 6 = 12 Weight)

PART C

Answer Any One

19. Make a lecutre note based on the following speech:
Ladies and gentlemen,
When other people are wasting their money going out with their mates, I'm doing something much more productive. It couldn't be better, really. It educates me, I have something beautiful to show at the end, and I make money too because the value of what I have is always increasing. You know what this marvel is? I collect stamps. To be precise, postage stamps. You know, the kind that you stick on letters… without thinking about it; the kind you casually throw into the bin every day. Perhaps tomorrow you'll think before you do so: that little coloured scrap in the corner of the envelope could already be worth a lot of money. In ten years it could be worth ten times as much. And think of it! Someone sent it to you for free! I know some collectors who have never bought a stamp in their lives, and their collection is worth tens of thousands.
Okay…, you say, "So it doesn't cost anything to tear the corner off an envelope. But how is that educational?" Well, just look at the stamps closely. They will tell you the history, the geography, the politics, the culture of a country – of all the countries of the world. The first thing you learn is how other people see themselves. The Hungarians call themselves Magyars; Albania is really Shqiperrija. You find scenes from their history, often with dates, names, great events…. You find pictures of their country, their houses, their people, their wildlife... You can see history unfolding….here's one from Zanzibar in 1962 when they declared independence; there was a revolution immediately and the new government overprinted it 'Jamhuru'. Overprints are always a treat, because it means a sudden change of events a surprise. Here are the stamps Britain, printed for the 1966 World Cup; and then, miraculously, England won – remember that last goal! – and the stamps were reissued over printed "England Winners". Amazing...! Or they can be sad: here's one from Germany in 1923 when the value of the currency was collapsing so fast they were constantly over printing new values. This one says 'two milliard Marks' – two thousand million Marks – about enough for a small loaf of bread.
I could go on. I have learnt so much about the whole world and all its history. And when the time comes I will sell my collection and retire on the proceeds. But until then, I shall marvel at these miniature treasure of designer's and the printer's art. A thing of beauty is a joy for ever.

20. Prepare a formal 10 minute oral presentation on the theme "Right to Information" based on the notes given below:



II **Any One of the following**

21. Practical I
22. Practical II

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U418**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 4 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP4CRMCP11 - DATA MINING**

(For Regular -2022 Admission and Improvement/Supplementary - 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. List any two ways by which big data can be integrated.
2. List any two ensembling methods.
3. Define constraint-based clustering.
4. To improve the efficiency of the level-wise generation of frequent itemsets, an important property called the Apriori property is used to reduce the search space. Define the Apriori property.
5. Name any two algorithms that are used for classification and prediction.
6. List any four steps involved in data pre-processing.
7. List any two examples of a frequent itemset.
8. Find the midrange from the following data:
   89, 77, 88, 91, 88, 93, 99, 79, 87, 84, 86, 82, 88, 89, 78
9. State the reason why clustering is also called data segmentation.
10. State how a market basket is represented for analysis.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. Classify and explain the outlier detection methods on the basis of supervision provided on the data.
12. Use these methods to normalize the following group of data: 200,300,400,600,1000
    (a) z-score normalization
    (c) normalization by decimal scaling
13. Write the procedure in Python / R that implements the Apriori Algorithm.
14. Discuss how binary representation helps in association analysis.
15. Discuss briefly the impacts of data mining in the society.
16. Differentiate between supervised learning and unsupervised learning.
17. Discuss briefly the k-fold cross validation technique of improving the classification accuracy.
18. Explain how data cube technology can be used as a data reduction technique.

(2 x 6 = 12 Weight)

PART C

Answer any 2

19. With an example, explain the induction of a decision tree using information gain.
20. With an example, explain how Chi-square test helps in data integration.

21. A database has five transactions as given below. Let min_sup = 60% and min_conf = 80%.

TID	items_bought
T100	{M, O, N, K, E, Y}
T200	{D, O, N, K, E, Y}
T300	{M, A, K, E}
T400	{M, U, C, K, Y}
T500	{C, O, O, K, I, E}

Find all frequent itemsets using Apriori and list all the strong association rules that hold.

22. Suppose that the data mining task is to cluster points (with *(x, y)* representing location) into three clusters, where the points are
$A_1(2,10)$, $A_2(2,5)$, $A_3(8,4)$, $B_1(5,8)$, $B_2(7,5)$, $B_3(6,4)$, $C_1(1,2)$, $C_2(4,9)$.
The distance function is Euclidean distance. Suppose initially we assign A_1, B_1, and C_1 as the center of each cluster, respectively. Use the k-means algorithm to show only
(a) The three cluster centers after the first round of execution.
(b) The final three clusters.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U436**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 4 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP4CRMCP12 - SOFTWARE ENGINEERING**

(For Regular 2022 Admission and Improvement / Supplementary - 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8 Questions

1. Define Software Engineering in simple terms.
2. Define the process - staffing in software project management.
3. Define reuse domain in domain analysis.
4. Define the term slack time in an activity network.
5. State how can you evaluate a software design to be good, with respect to cohesion and coupling.
6. State the main goal of structured design.
7. State the objective of coding phase.
8. Define the term project risk.
9. State the reason behind saying that it is not possible to guarantee that a program or software is error free.
10. List any two drawbacks of command-based user interface.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. While developing the user interface for a software product, explain how can you accomodate users with different skill levels.
12. Discuss the problems that would gear up if a software development organization does not follow any SDLC model for development of large-sized software.
13. Discuss the need of designing test cases.
14. Explain the important causes of and remedies for high coupling between two software modules.
15. With a diagram, explain how a Gantt chart helps in project planning.
16. Differentiate between the activities - verification and validation.
17. Discuss the various items that should be designed and documented during the design phase.
18. Explain why every software system must undergo maintenance or progressively become less useful.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Elaborate on the process of constructing a DFD for a software project.
20. Explain the code review techniques in detail.
21. Describe the V-model in detail. Also, list and explain its advantages and disadvantages.
22. Management of software projects is much more complex than management of many other types of projects. Discuss the major factors contributing to the complexity of managing a software product.

(5 x 2 = 10 Weight)

Reg. No .....

Name **24U452**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 4 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP4CRMCP13 - BASICS OF ARTIFICIAL INTELLIGENCE**

(For Regular 2022 Admission and Improvement / Supplementary - 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8 Questions

1. The value of generating function $1 + a + a^2 + a^3 + \ldots\ldots = $
2. If the proposition *p* states "I bought a lottery ticket this week.", and *q* states "I won the million dollar jackpot.", express the proposition *¬p ∨ (p ∧ q)* in English sentences.
3. The value of the generating function $1 - x + x^2 - x^3 + x^4 - \ldots\ldots\ldots = $
4. Write the formula to find the derivative of a real-valued function using first principle.
5. State the derivative of logistic function.
6. List any two examples of variables that would be strongly correlated.
7. The binomial expansion of e^x is _____.
8. State the rule of inference used in the argument "If it snows today, the university will close. The university is not closed today. Therefore, it did not snow today"
9. When a die is rolled, let A be the event that an even number turns up and let B be the event that a number divisible by 3 occurs. Find $P(A \cup B)$ and $P(A \cap B)$.
10. List any four heuristic search techniques commonly used in AI-based problem solving.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Explain the hill climbing algorithm with an example.
12. Discuss the right shift rule of generating functions with an example.
13. Four cards are drawn from a pack of cards, Find the probability that (i) there is one card of each suit, and (ii) there are two spades and two hearts.
14. Find the value of $\lim_{x \to 1} \left[\frac{x-2}{x^2-x} - \frac{1}{x^3-3x^2+2x} \right]$
15. A box contains 6 red, 4 white and 5 black balls. A person draws 4 balls from the box at random. Find the.probability that among the balls drawn, there is at least one ball of each colour.
16. Discuss the various applications of Propositional logic.
17. Perform a critical comparison of breadth-first and depth-first search algorithms.
18. Find $\frac{dy}{dx}$, if $y + \sin y = \cos x$.

(2 x 6 = 12 Weight)

PART C
Answer any 2 Questions

19. Discuss the characteristics of an AI-based problem based on which it can be categorized.

20. Find $\frac{\mathrm{d}\,y}{\mathrm{d}\,x}$ of the following functions:

    (a). $\mathrm{y} = \cos^{-1}\left(\frac{1-\mathrm{x}^2}{1+\mathrm{x}^2}\right),\ 0 < \mathrm{x} < 1$

    (b). $\mathrm{y} = \sin^{-1}\left(\frac{2\mathrm{x}}{1+\mathrm{x}^2}\right)$

21. Elaborate on the Gaussian distribution with its main characteristics.

22. Find the generating function of the sequence: $0^2,\ 1^2,\ 2^2,\ 3^2,\ 4^2,\ \ldots.$

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U468**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 4 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP4CPSTA02 - PROBABILITY DISTRIBUTIONS AND STATISTICAL INFERENCE**

(For Regular 2022 Admission and Improvement / Supplementary 2021 Admissions)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8 Questions

1. Write a statistic for testing the mean of a normal distribution with (i) known standard deviation (ii) unknown standard deviation.
2. 150 heads and 250 tails resulted from 400 tosses of a coin find 90% confidence interval for the proportion of head?
3. Compare and contrast a standard normal distribution and a student's 't' distribution.
4. A random sample of 500 pineapples was taken from a large consignment and 65 of them were found to be bad. Find 99% confidence interval for the proportion of bad pineapples.
5. Distinguish between null and alternative hypothesis.
6. A random sample of size 16 from a normal distribution N(μ,25) yielded $\overline{X}$ = 73.8. Find the 95% confidence interval for μ?
7. Define binomial distribution. Determine the binomial distribution for which the mean is 4 and variance 3.
8. Define 't' distribution?
9. The mean and variance of binomial distribution with parameters n and p are 16 and 8. Find P(X=0)
10. A sample of 12 specimen taken from a normal population is expected to have a mean =50. The sample has mean 64 with a variance 25. Write the test statistic for testing, H_0: $\mu = \mu_0$ against H_1:$\mu \neq \mu_0$

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Two random samples are taken from normal populations resulting in the following statistic. Test whether the samples can be regarded as coming from the same normal population.

size	mean	s.d.
16	34	2.5
25	45	2.5

12. Show that the exponential distribution 'lacks memory' .
13. If X and Y are independent Poisson variate such that P(X=1)=P(X=2) and P(Y=2)=P(Y=3). Find the Variance of X-2Y.
14. Six observations 8, 6, 9, 12, 5 and 11 are taken from a normal population. Obtain (a)95% (b) 99% confidence interval for the population variance.
15. Define (1) simple random samplig (2) systematic sampling (2) stratified sampling.
16. Explain the method of paired t test.

17. In Poisson frequency distribution, frequency corresponding to 3 successes is 2/3 times frequency corresponding to 4 successes. Find the mean and standard deviation of the distribution.

18. Give an example each of an estimator that is (i) both unbiased and consistent (ii) not unbiased but consistent.

(2 x 6 = 12 Weight)

PART C
Answer any 2 Questions

19. i) Define chi-square distribution and state its applications ii) Define 't' distribution and state its assumptions.

20. Give an example each of an estimator that is (i) not unbiased but consistent (ii) unbiased but not consistent.

21. Fit a Binomial distribution and obtain theoretical frequencies

No. of defectives :	0	1	2	3	4
No. of packets :	46	28	18	6	2

22. A certain drug is claimed to be effective in curing cold. In an experiment on 164 people with cold, half of them were given the drug and othe other half was given sugar pills. The patient reaction to the treatment are presented in the following table. On the basis of this data can it be concluded that there is a significant difference in the effect of the drug and sugar pills.

	Helped	Harmed	No effect
Drugs	52	10	20
Sugar pills	44	12	26

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U518**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 5 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP5CRMCP14 : PRINCIPLES OF MACHINE LEARNING**

(For Regular 2021 Admission)

Time : Three Hours **Max.Weightage** : **30**

PART A

Answer any 8

1. Define the concept - model parameter tuning.
2. List any two applications in which machine learning has proved to be worthier than human learning.
3. Define the inverse logit function for a single variable logistic regression.
4. Define the inverse logit function for a multi-variable logistic regression.
5. Define the term 'bias' in the context of neural network.
6. List any two methods by which accuracy of a linear regression model can be improved.
7. State the use of `sklearn` library in Python.
8. Define the term residual in regression analysis.
9. Define the concept - linearly separable data.
10. List any two applications of supervised learning with ANN.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. State the assumptions that must hold when building a logistic regression model.
12. Discuss the significance of using c - hyperparameter in SVM.
13. Explain the process of classification for linearly inseparable data using SVM.
14. There has been a rapid growth in data considering more number of features of the data under study. Explain how these features can be treated keeping in mind the performance requirements of the model.
15. Briefly discuss how unsupervised learning is performed by neural networks.
16. Discuss briefly the case of underfitting a regression model.
17. Write short notes on underfitting a model. Suggest some methods by which underfitting can be reduced.
18. Explain Bayes theorem and its associated terminologies with an example.

(2 x 6 = 12 Weight)

PART C

Answer any 2

19. Elaborate on the various types of Bayesian models.
20. Define regularization. Explain how regularization helps in preventing overfitting in linear regression.
21. Elaborate on the structure and functioning of a Biological Neural Network.
22. List and explain the various activities involved in machine learning.

(5 x 2 = 10 Weight)

Reg. No ..... Name **23U534**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 5 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP5CRMCP15 : WEB APPLICATION DEVELOPMENT USING PHP**

(For Regular - 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8

1. In the style `.sel{ width:20ex; }` , state what does "ex" indicate.
2. If a form has to offer three choices to a user, each of which is mutually exclusive so that only one of the three can be selected, identify which input type would be used?
3. If `$conn` is a variable that stores the connection, write the code that terminates the connection with MySQL database.
4. Define the term 'event' in the context of web programming.
5. State the main difference between a descendent selector and a child selector.
6. State the use of `$.map` method in jQuery.
7. Find the value of the variable `$total` after the end of the loop:

```
$total = 0;
for ($i = 1; $i <= 5; $i++) {
  if ($i % 2 == 0) {
    continue; }
  $total += $i;
}
```

8. List any four predefined constants in PHP.
9. Write an example of a multiline string variable assignment.
10. Name a way to return multiple values from a function.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. Define Pseudoclasses. Explain its significance with an example.
12. List the rules of defining variables in PHP.
13. Explain how the combination of selectors are used by jQuery in event handling. Create a sample HTML file illustrating the same.
14. With an example, explain how JavaScript files can be included externally.
15. With an example for each, differentiate between `break` and `continue` statements.
16. Write the sample code to create a MySQL table using PHP code.
17. Write PHP code to update the "email" column in a "users" table where the "username" is "john" to "john@example.com".
18. JavaScript can be used to access HTML elements and modify them. Justify this statement with an example.

(2 x 6 = 12 Weight)

PART C
Answer any 2

19. Elaborate on the various measurement units supported by CSS, with an example.
20. Differentiate between passing function arguments by copy and by reference. Also explain how functions can be dynamically accessed.
21. With an example for each, explain how the click and double click events are triggered using jQuery.
22. List and explain any 5 built-in array functions in PHP. Write a sample code illustrating the same.

(5 x 2 = 10 Weight)

END SEMESTER EXAMINATION – OCTOBER 2024

SEMESTER 5: INTEGRATED M. Sc. PROGRAMME IN COMPUTER SCIENCE – DATA SCIENCE

COURSE : 21UP5CRMCP16: PROGRAMMING IN JAVA

(For Regular – 2022 Admission & Supplementary 2021 Admissions)

Time: 3 Hours **Total Weightage: 30**

PART A

Answer any 8 (1 weight each)

1. Write the syntax for instantiating an array.
2. List any four built-in string functions.
3. List any four primitive data types supported by Java.
4. State the purpose of 'finally' keyword.
5. State the reason why Java is termed as a robust language.
6. List the two ways of creating a custom thread class.
7. Define the term event.
8. List any two swing components.
9. Define the term applet.
10. List any functions of graphics class.

PART B

Answer any 6 (2 weights each)

11. Explain labelled loops with an example
12. Write a program to calculate the grade of a student using switch case.
13. Prepare short notes on the various visibility control modes.
14. Define final variables. With a program, explain the use of final variables and methods.
15. Write a program to add two matrices.
16. Write short notes on packages.
17. Explain how a class is inherited from another class.
18. Explain how java indirectly implements multiple inheritance.

PART C

Answer any 2 (5 weights each)

19. Define the term exception. Elaborate on the exception handling mechanism in Java.
20. Design a GUI using Swing components for entering the marks of a student.
21. Elaborate on event delegation model.
22. Define constructor. With an example, explain how constructors are overloaded.

Reg. No ..... Name **23U571**

END SEMESTER EXAMINATION : NOVEMBER 2023

SEMESTER 5 : INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP5CRMCP17 : IT AND ENVIRONMENT**

(For Regular 2021 Admission)

Time : Three Hours **Max. Weightage** : **30**

PART A

Answer any 8

1. Define the term 'Green Computing'.
2. Comment on 'I'm feeling lucky' button in Google.
3. Expand INFLIBNET.
4. Discuss the categories of cyber crime.
5. Mention any two types of cyber addictions.
6. List the E-waste generators.
7. List the features of a knowledge repository.
8. Recall explicit inclusion in Google.
9. Comment on assessment software.
10. Expand UDHR.

(1 x 8 = 8 Weight)

PART B

Answer any 6

11. Suggest some steps for the proper disposal of e-waste.
12. Define a repository.Mention its types.
13. Explain the role and functions of the National Human Rights Commission in India.
14. Briefly explain the working principle of NICNET.
15. Explain how the internet has revolutionized the way information is stored and accessed.
16. Examine how individuals manage information overload and maintain a healthy digital lifestyle.
17. Discuss the signs and symptoms of cyber addiction.
18. Describe how has India embraced green computing practices in its IT industry.

(2 x 6 = 12 Weight)

PART C

Answer any 2

19. Discuss the impact of mobile phones in your daily life activties. Identify its pros and cons.
20. Discuss the scope of environmental studies. How does it relate to various fields of science, social sciences, and humanities?
21. Explain in detail software piracy and its types. Explain the steps that can be taken to prevent software piracy.
22. Explain how State Human Rights Commissions complement the work of the National Human Rights Commission.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U616**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 6 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP6CRMCP18 - LINUX AND SHELL PROGRAMMING**

(For Regular - 2021 Admission)

Time : Three Hours Max. Weightage : 30

PART A

Answer any 8 Questions

1. Explain the role of comments in a shell script.
2. The _____ command allows you to search for files based on their names or content.
3. Mention the email clients in Linux.
4. Expand and describe PAM.
5. List the key options used with the umount command for unmounting file systems.
6. Mention the hardware requirements of installing Linux OS.
7. Define Kernel.
8. State the purpose of 'chrt' command.
9. Recall the basic syntax of the fdisk command.
10. In Bash, you can create and use _____ to simplify frequently used commands.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Explain with an example how to delete a disk partition.
12. Explain GRUB in detail.
13. Explain the difference between ..... and ..... giving suitable examples.
14. Discuss password aging policies in detail.
15. Describe the role of the "htop" utility in identifying and managing CPU and memory usage in Linux.
16. Write short note on environment variables.
17. List the key options or parameters available with the fdisk command.
18. Explain the mathematical commands in Linux.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Define various file types in a Linux file system and discuss their characteristics and examine the role of file permissions in file management.
20. Explain processor scheduling in detail.
21. Write a shell script to create a menu driven calculator and explain the script in detail.
22. a. Compare any five Linux distributions and its features. b. Explain its advantages.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U634**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 6 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP6CRMCP19 - COMPUTER NETWORKS**

(For Regular - 2021 Admission)

Time : Three Hours Max. Weightage : 30

PART A

Answer any 8 Questions

1. In _____ switching, each packet is treated independently and may take a different route to reach its destination.
2. Differentiate between net id and host id.
3. Define Digital signature.
4. Express your views on how an Adhoc network is different from traditional infrastructure based networks.
5. Identify the common sources of distortion in communication channels.
6. Discuss the categories of cryptography.
7. Define jitter in network communication.
8. Expand CSMA.
9. Recall the basic units used to represent information in a digital signal.
10. _____ cables and _____ cables are examples of guided transmission media.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Explain unguided media, and how it differs from guided media.
12. Discuss about phishing attack and suggest methods to protect individuals and organizations against phishing attempts.
13. Discuss the potential security benefits associated with IPv6 addressing.
14. Examine the relationship between frequency and attenuation in signal propagation.
15. Discuss the significance of private and public IP addresses in IPv4.
16. Comment on Rotation ciphers.
17. Explain the taxonomy of protocols.
18. Explain the concept of connectionless communication in datagram networks.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Define the concepts of data and signals in the context of communication systems. Discuss the fundamental differences between analog and digital signals and their applications.
20. Analyze the various types of malware and their impact on network security, discussing preventive measures and mitigation strategies.
21. Compare Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS) techniques.
22. Discuss the concept of address classes in IPv4, including Class A, B, and C addresses. Explain how classful addressing influenced IPv4 address assignments and routing.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U650**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 6 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP6CRMCP20 - MOBILE APPLICATION DEVELOPMENT USING KOTLIN**

(For Regular - 2021 Admission)

Time : Three Hours Max. Weightage : 30

PART A

Answer any 8 Questions

1. Predict the output of the following code in the context of data classes:
```
data class Person(val name: String, val age: Int)
fun main() {
    val person = Person("John", 30)
    println(person.toString())
}
```
2. List the methods that are automatically derived by the compiler when a data class is defined.
3. List any two ways to register a receiver for broadcast receivers.
4. In the context of execution of statements (Threads), the general procedure follows three steps. Identify the steps.
5. Given the following piece of code, predict the output printed:
```
fun main() {
    val name: String? = "John"
    println(name?.length)
}
```
6. Arrays are static in nature. List any two data structures in Kotlin that helps you to code data structures of dynamic nature.
7. Predict the output of the following code when executed:
```
fun main() {
    val num1: Int = 10
    val num2 = 3
    println(num1 / num2)
}
```
8. Evaluate the following piece of code and predict the output:
```
fun main() {
  val array = arrayOf(1, 2, 3, 4, 5)
  println(array.joinToString(","))
}
```
9. According to Android 6.0's compatibility definition, state the minimum storage capability required (in GB) by Android phones/tablets for user space.
10. List any two ways by which a custom thread can be created.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Discuss with an example, how generic classes are created and instantiated.
12. Discuss the advantages and drawbacks of internal and external storage from the viewpoint of an Android programmer.

13. Prepare a detailed note on infix functions.
14. Explain how default values can be provided for interface methods.
15. Explain how intents are used to send data from a secondary activity back to its main activity.
16. With an example, explain higher order functions and defining function types in Kotlin.
17. Discuss the various data types supported by Kotlin.
18. Write a Kotlin program to calculate Simple Interest by overloading a method called `calcInterest()`. The method takes three arguments - principal, time, and rate.

(2 x 6 = 12 Weight)

PART C
Answer any 2 Questions

19. With suitable examples, explain how functions return a single value and a pair of values.
20. Explain how the `setOnClickListener()` method is used in event handling.
21. Elaborate with necessary examples, on any two collections of `iterable` type.
22. With necessary examples, explain how branched execution is performed in Kotlin.

(5 x 2 = 10 Weight)

Reg. No ..... Name **24U668**

END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 6 - INTEGRATED M.Sc. PROGRAMME COMPUTER SCIENCE

COURSE : **21UP6CRMCP20EL - FULL STACK PROGRAMING TECHNIQUES**

(For Regular - 2021 Admission)

Time : Three Hours Max. Weightage: 30

PART A

Answer any 8 Questions

1. List any two examples of online HTML editors.
2. State the use of `<noscript>` tag.
3. State the significance of projection parameter in querying data.
4. Name the three important components of a node.js application.
5. List any two examples of relational databases.
6. Interpret the meaning of the following style:
   ```
   margin: 1px 2px 3px 4px;
   ```
7. State the significance of the *App.js* file in React.
8. State the use of React webpack.
9. State the purpose of NodeJS.
10. Name any two methods by which JavaScript can display text output.

(1 x 8 = 8 Weight)

PART B

Answer any 6 Questions

11. Explain how type selectors are used for styling in CSS. Write example for the same.
12. Explain the working environment of Node.js.
13. Explain the use of `break` statement in JavaScript with an example.
14. Write short notes on relational and logical operators in JavaScript with an example.
15. With an example for each, differentiate between `find()` and `findOne()` methods in MongoDB.
16. Explain how lists are rendered in React. Write a sample program illustrating the same.
17. Explain how links can be established among HTML pages. Create a sample HTML page demonstrating the same.
18. Discuss the working of React in the client side.

(2 x 6 = 12 Weight)

PART C

Answer any 2 Questions

19. Discuss how branched execution of statements work in JavaScript.
20. With a sample program, explain how props are managed using functional components.
21. With a sample HTML code, prepare detailed note on ordered and unordered list tags.
22. Elaborate on the implementation of update operators supported by MongoDB.

(5 x 2 = 10 Weight)

END SEMESTER EXAMINATION – OCTOBER 2024

SEMESTER 7: INTEGRATED M. Sc. PROGRAMME IN COMPUTER SCIENCE – DATA SCIENCE

COURSE : 21UP7CRMCP21: ADVANCED PYTHON PROGRAMMING FOR DATA SCIENCE

(For Regular – 2021 Admission)

Time: 3 Hours **Total Weightage: 30**

PART A

Answer any 8 (1 weight each)

1. Define decorator functions.
2. Define model persistence. Name the Python module that helps in model persistence.
3. List any four sub-packages of `scipy` module.
4. List any two examples of image datasets.
5. Recollect the importance of regular expressions. Name the Python module that is used for this purpose.
6. List any four application areas where `NumPy` is extensively used.
7. Define cursor in the `mysql` module.
8. Name the Python libraries that allows programmers to provide interoperability with C and Java.
9. Define Reinforcement learning.
10. List any four datatypes used in TensorFlow.

PART B

Answer any 6 (2 weights each)

11. Write short notes on Exception Handling techniques in Python.
12. With a sample program, explain the steps involved in client-server communication using TCP/IP.
13. With suitable examples, explain how indexing and slicing is performed in Python.
14. Discuss data modeling with `sklearn`.
15. With an example for each, explain stemming and lemmatization.
16. Explain how onehot encoding is performed in Python. Write an example for the same.
17. With an example, explain `filter()` in Python.
18. Prepare short notes on Regression techniques in Machine Learning.

PART C

Answer any 2 (5 weights each)

19. Define perceptron. With an example, explain the working of Convolutional Neural Networks.
20. With sample programs, explain how DML operations are performed with MySQL (or any relational database) using Python.
21. Define serialization. Explain the various ways of data serialization in Python.
22. Discuss the steps involved in installing TensorFlow with GPU support on a Linux System.

END SEMESTER EXAMINATION – OCTOBER 2024

SEMESTER 7: INTEGRATED M. Sc. PROGRAMME IN COMPUTER SCIENCE – DATA SCIENCE

COURSE : 21UP7CRMCP24 : DATA ENGINEERING IN DATA SCIENCE

(For Regular – 2021 Admission)

Time: 3 Hours **Total Weightage: 30**

PART A

Answer any 8 (1 weight each)

1. Name the full text search engine library used by elastic search.
2. What do you mean by dangling tuples?
3. What are data pipelines?
4. Why do we need selenium?
5. What is data wrangling?
6. What is the purpose of using a pip command in python.
7. Write any two python libraries for parsing excel files.
8. Give any two differences between structured data and unstructured data.
9. What are the two different nodes found in HDFS?
10. What do you mean by webscraping?

PART B

Answer any 6 (2 weights each)

11. What is the difference between vertical and horizontal fragmentation?
12. Explain the various normalization forms.
13. Discuss the architecture of HDFS with the help of a diagram.
14. Explain the two models of data replication with suitable diagrams.
15. Explain how can we read a web page with Beautiful Soup using python code.
16. Discuss the various steps in creating groups and investigating their relationships with the help of python.
17. What are the different types of elastic search nodes?
18. Write python code for building a scatter chart using Bokeh library.

PART C

Answer any 2 (5 weights each)

19. Explain various hashing methods used in database systems.
20. What are the different summarization techniques used in streaming data analytics?
21. Explain various steps in data clean up basics process.
22. Explain heuristic query optimization using an example.