ST. JOSEPH’S COLLEGE (AUTONOMOUS), DEVAGIRI, CALICUT

FOR

DEGREE OF
BACHELOR OF SCIENCE (B.Sc.)
in
Computer Science & Mathematics
(Double Main)

(UNDER SJCBCSSUG 2019 SYSTEM)

(EFFECTIVE FROM 2022 ADMISSION)

COURSE DESCRIPTION AND PROVISIONS

(As per SJCBCSS UG 2019 Regulations)

1. DEFINITIONS

1. **‘Programme’** means the entire course of study and examinations for the award of a degree.
2. ‘**Duration of programme**’ means the time period required for the conduct of the programme. The duration of a UG degree programme shall be six semesters distributed in a period of 3 years or eight semesters in a period of 4years.
3. ‘**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 on each day. A sequence of 18 such academic weeks constitutes a semester.
4. ‘**Semester**’ means a term consisting of 18 weeks (16 instructional weeks and two weeks for examination).
5. ‘**Course**’ means a segment of subject matter to be covered in a semester.
6. ‘**Common course**’ means a course that comes under the category of courses, including compulsory English and additional language courses and a set of general courses applicable for Language Reduced Pattern (LRP) programmes, the selection of which is compulsory for all students undergoing UG programmes.
7. ‘**Core course**’ means a compulsory course in a subject related to a particular degree programme.
8. ‘**Open course**’ means a course which can be opted by a student at his/her choice.
9. **‘Improvement course**’ is a course registered by a student for improving his/her performance in that particular course.
10. ‘**Ability Enhancement course/ Audit course**’ is a course which is mandatory as per the directions from the Regulatory authorities like UGC, Supreme Court etc.
11. ‘**Department**’ means any Teaching Department in a college offering a course of study approved by the University as per the Statutes and Act of the University.
12. ‘**Department Co-ordinator**’ is a teacher nominated by a Dept. Council to co-ordinate all the works related to CBCSSUG undertaken in that department including continuous evaluation.
13. **‘Department Council**’ means the body of all teachers of a department in a college.
14. ‘**Parent Department**’ means the Department which offers a particular degree programme. The parent department shall be either mathematics or Computer

Science which offer core papers in this programme.

15. ‘**College Co-coordinator**’ is a teacher nominated by the college council to co-ordinate the effective running of the process of CBCSS including internal evaluation undertaken by various departments within the college. She/he shall be the convenor for the College level monitoring committee.

16. ‘**College level monitoring committee’.** A monitoring Committee is to be constituted for CBCSS UG at the college level with Principal as Chairperson, college co-ordinator as convenor and department coordinators as members. The elected College union chair person shall be a member of this committee.

17. ‘**Faculty Adviser**’ means a teacher from the parent department nominated by the Department Council, who will advise the student in the academic matters and in the choice of open courses.

18. ‘**Credit**’**(C)** is a unit of academic input measured in terms of weekly contact hours/course contents assigned to a course.

19. ‘**Extra Credit**’ is the additional credit awarded to a student over and above the minimum credits required in a programme, for achievements in co-curricular activities and social activities conducted outside the regular class hours, as decided by the University. For calculating CGPA, extra credits will not be considered.

20. ‘**Letter Grade**’ or simply ‘Grade’ in a course is a letter symbol (O,A+, A,B+, B, C, P, F, I and Ab). Grade shall mean the prescribed alphabetical grade awarded to a student based on his/her performance in various examinations. The Letter grade that corresponds to a range of CGPA is given in Annexure- I.

21. Each letter grade is assigned a ‘**Grade Point**’ **(G)** which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course. **Grade Point** means point given to a letter grade on 10 point scale.

22. ‘**Semester Grade Point Average’ (SGPA)** is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a semester by the total number of credits in that semester. SGPA shall be rounded off to three decimal places. SGPA determines the overall performance of a student at the end of a semester.

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

24. ‘**Cumulative Grade Point Average**’ **(CGPA)** is the value obtained by dividing the sum of credit points in all the semesters taken by the student for the entire

programme by the total number of credits in the entire programme and shall be rounded off to three decimal places.

25. **Grade Card** means the printed record of students' performance, awarded to him/her.
26. **Course teacher:** A teacher nominated by the Head of the Department shall be in charge of a particular course.
27. '**Dual core'** means a programme with double core subjects, traditionally known as double main.
28. **'Strike off the roll' A s**tudent who is continuously absent for 14 days without sufficient reason and proper intimation to the Principal of the college shall be removed from the roll.

    Words and expressions used and not defined in the regulation, but defined in the Calicut University Act and Statutes shall have the meaning assigned to them in the Act and Statutes.

2. PROGRAMME STRUCTURE

Duration: The duration of a UG Programme shall be 6 semesters distributed over a period of 3 academic years. The odd semesters (1, 3, 5) shall be from June to October and the even semesters (2, 4, 6) shall be from November to March.

Courses: The UG programme shall include five types of courses, viz; Common Courses (Code A), Core courses (Code B), Open Course (Code D), Elective courses (Code E) and Audit courses (Code F).

Course code: Each course shall have a unique alphanumeric code number, which includes Letter G representing syllabus revision 2019, abbreviation of the subject in three letters, the semester number (1 to 6) in which the course is offered, the code of the course (A to E) and the serial number of the course (01, 02 ……) last digit T for theory, P for practical, D for dissertation/project, V for Viva-Voce and F for Field study/ Tour report. Core courses and courses in a particular complementary will be numbered continuously.

Common Courses: In general, every UG student shall undergo 10 common courses (total 38 credits) chosen from a group of 14 common courses listed below, for completing the programme.

A01. Common English Course 1	English courses A01-A06 applicable to BA/BSC Regular pattern
A02. Common English Course II	English courses A01-A04 applicable to Language Reduced Pattern (LRP) Programmes B.com, BBA, BBA (T), BBM, BSc (LRP), BCA etc.
A03. Common English Course III	
A04. Common English Course IV	
A05. Common English Course V	
A06. Common English Course VI	
A07. Additional Language Course I	Addl. Language courses A07-A10 applicable to BA/BSc Regular Pattern
A08. Additional Language Course II	
A09. Additional Language Course II	Addl. Language courses A07-A08 applicable to Language Reduced Pattern (LRP) Programmes
A10.Additional Language Course IV	
A11. General Course I	Applicable to Language Reduced Pattern (LRP) Programmes
A12. General Course II	
A13. General Course III	
A14. General Course IV	

Common courses A01-A06 shall be taught by English teachers and A07-A10 by teachers of additional languages respectively. General courses A11-A14 shall be offered by teachers of departments offering core courses concerned.

General courses I, II, III and IV shall be designed by the group of boards concerned.

Core courses: Core courses are the courses in the major (core) subject of the degree programme chosen by the student. Core courses are offered by the parent department.

Open courses: There shall be one open course in core subjects in the fifth semester. The open course offered in Mathematics shall be open to all the students in the institution except for the students having Mathematics as Core Course. The students can opt that course from any other department in the institution. Each department can decide the open course from a pool of three courses offered by the University. Total credit allotted for open course is 3 and the hours allotted is 3. If there is only one programme in a college, they can choose either language courses or physical education as open course.

Ability Enhancement courses/ Audit courses: These are courses which are mandatory for a programme but not counted for the calculation of SGPA or CGPA. There shall be one Audit course each in the first four semesters. These courses are not meant for class room study. The students can attain only pass (Grade P) for these courses. At the end of each semester there shall be examination conducted by the college from a pool of questions (Question Bank) set by the College. The students can also attain these credits through online courses like SWAYAM, MOOC etc. (optional). The list of courses in each semester with credits is given below.

Course with credit	Semester
Environmental Studies- 4	1
Disaster Management- 4	2
Intellectual Property Rights- 4	3
Gender Studies- 4	4

*College can opt any one of the courses.

4.11. Extra credit Activities: Extra credits are mandatory for the programme. Extra credits will be awarded to students who participate in activities like NCC, NSS and Swatch Bharath. Those students who could not join in any of the above activities have to undergo Social Service Programme (SSP). Extra credits are not counted for SGPA or CGPA.

Credits: A student is required to acquire a minimum of 140 credits for the completion of the UG programme, of which 120 credits are to be acquired from class room study and shall only be counted for SGPA and CGPA. Out of the120 credits, 38 (22 for common English courses and 16 for common languages other than English) credits shall be from common courses, 2 credits for project/ corresponding paper and 3 credits for the open course. The maximum credits for a course shall not exceed 5. Dual core programmes are having separate credit distribution. Audit courses shall have 4 credits per course and a total of 16 credits in the entire programme. The maximum credit acquired under extra credit shall be 4. If more Extra credit activities are done by a student that may be mentioned in the Grade card. The credits of audited courses or extra credits are not counted for SGPA or CGPA.

Attendance: A student shall be permitted to appear for the semester examination, only if he/ she secures not less than75% attendance in each semester. Attendance shall be maintained by the Department concerned. Condonation of shortage of attendance to a maximum of 10% in the case of single condonation and 20% in the case of double condonation in a semester shall be granted by University remitting the required fee. Benefits of attendance may be granted to students who attend the approved activities of the college /university with the prior concurrence of the Head of the institution. Participation in such activities may be treated as presence in lieu of their absence on production of participation/ attendance certificate (within two weeks) in curricular/ extracurricular activities (maximum 9 days in a semester). Students can avail of condonation of shortage of attendance in a maximum of four semesters during the entire programme (Either four single condonations or one double condonation and two single condonation during the entire programme). If a student fails to get 65% attendance, he/she can move to the next semester only if he/she acquires 50% attendance. In that case, a **provisional registration** is needed. Such students can appear for supplementary examination for such semesters after the completion of the programme. Less than 50% attendance requires Readmission. Readmission is permitted only once during the entire programme.

Grace Marks: Grace Marks may be awarded to a student for meritorious achievements in co-curricular activities (in Sports/Arts/NSS/NCC/Student Entrepreneurship) carried out besides the regular hours. Such a benefit is applicable and limited to a maximum of 8 courses in an academic year spreading over two semesters. In addition, maximum of 6 marks per semester can be awarded to the students of UG Programmes, for participating in the College Fitness Education Programme (COFE).

Project: Every student of a UG degree programme shall have to work on a project of 3 credits under the supervision of a faculty member or shall write a theory course based on Research Methodology as per the curriculum. College shall have the liberty to choose either of the above. The Project work for BSc Computer Science &Mathematics is offered by The Department of Computer Science

3. ADMISSION

The admission to the programme will be as per Rules and Regulations of the University. Admission to this Degree Programme shall be open only to candidates who have passed the Plus Two in science with Mathematics as one of the subjects of the Higher Secondary Board of Kerala or Pre-Degree of any University in Kerala or that of any other University or Board of Examinations in any state recognized as equivalent to the Plus Two of the Higher Secondary Board in Kerala.

The admitted candidates shall subsequently undergo the course of study in the college for six semesters within a period of not less than three years; clear all the examinations prescribed and fulfil all such conditions as prescribed by the University from time to time.

4. EVALUATION AND GRADING

Mark system is followed instead of direct grading for each question. For each course in the semester letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given in Annexure-1

Course Evaluation

The evaluation scheme for each course shall contain two parts:

1) Internal assessment; 2) External Evaluation

20% weight shall be given to the internal assessment. The remaining 80% weight shall be for the external evaluation.

Internal Assessment

20% of the total marks in each course are for internal examinations. The internal assessment shall be based on a predetermined transparent system involving written tests, Class room participation based on attendance in respect of theory courses and lab involvement/ records attendance in respect of Practical Courses. Internal assessment of the project will be based on its content, method of presentation, final conclusion and orientation to research aptitude. Components with percentage of marks of Internal Evaluation of Theory Courses are- Test paper 40%, Assignment 20%, Seminar 20% and Class room participation based on attendance 20%. For the test paper marks, at least one test paper should be conducted. If more test papers are conducted, the mark of the best one should be taken. To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be notified on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal marks. The Split up of marks for Test paper and Class Room Participation (CRP) for internal evaluation are as follows.

Split up of marks for Test paper

Range of Marks in Test Paper	Out of 8 (Maximum internal Marks is 20)	Out of 6 (Maximum internal marks is 15)
Less than 35%	1	1
35%- 45%	2	2
45% - 55%	3	3
55% - 65%	4	4
65% -85%	6	5
85% -100%	8	6

Split up of marks for Class Room Participation

Range of CRP	Out of 4 (Maximum Internal marks is 20)	Out of 3 (Maximum internal marks is 15)
50% ≤CRP <75%	1	1
75% ≤CRP <85%	2	2
85 % and above	4	3

External Evaluation

External evaluation carries 80% of marks. The external question papers may be of uniform pattern with 80/60 marks. The courses with 2/3 credits will have an external examination of 2 hours duration with 60 marks and courses with 4/5 credits will have an external examination of 2.5 hours duration with 80 marks.

The external examination in theory courses is to be conducted by the University with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external examination in practical courses shall be conducted by two examiners–one internal and an external, the latter appointed by the COE of the college. The project evaluation with viva can be conducted either internal or external which may be decided by the Board of Studies concerned.

After the external evaluation only marks are to be entered in the answer scripts.

Revaluation: In the new system of grading, revaluation is permissible. The prevailing rules of revaluation are applicable to SJCBCSSUG2019.

Students can apply for photocopies of answer scripts of external examinations. Applications for photocopies/scrutiny/revaluation should be submitted within 10 days of publication of results. The fee for this shall be as decided by the University.

5. INDIRECT GRADING SYSTEM

Indirect grading System based on a 10-point scale is used to evaluate the performance of students. Each course is evaluated by assigning marks with a letter grade (O, A+, A, B+, B, C, P, F, I or Ab) to that course by the method of indirect grading (See Annexure).

An aggregate of P grade (after external and internal put together) is required in each course for a pass and also for awarding a degree (A minimum of 20% marks in external evaluation is needed for a pass in a course. But no separate pass minimum is needed for internal evaluation). No separate grade/ mark for internal and external will be displayed in the grade card; only an aggregate grade will be displayed. Also the aggregate mark of internal and external is not displayed in the grade card.

A student who fails to secure a minimum grade for a pass in a course is permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student should pass all courses. However, a student is permitted to move to the next semester irrespective of SGPA obtained.

SGPA of the student in that semester is calculated using the formula

$$\textbf{SGPA} = \frac{\text{Sum of the credit points of all courses in a semester}}{\text{Total credits in that semester}}$$

The Cumulative Grade Point Average (CGPA) of the student is calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students. CGPA can be calculated by the following formula.

$$\textbf{CGPA} = \frac{\text{Total credit points obtained in six semesters}}{\text{Total credits acquired (120)}}$$

SGPA and CGPA shall be rounded off to three decimal places. CGPA determines the broad academic level of the student in a programme and is the index for ranking students (in terms of grade points). An overall letter grade (cumulative grade) for the entire programme shall be awarded to a student depending on her/his CGPA (Annexure-I).

6. METHOD OF INDIRECT GRADING

Evaluation (both internal and external) is carried out using Mark system. The Grade on the basis of total internal and external marks will be indicated for each course, for each semester and for the entire programme.

Indirect Grading System in 10- point scale is as below:

ANNEXURE I

Percentage of Marks (Both Internal & External put together)	Grade	Interpretation	Grade point Average (G)	Range of grade points	Class
95 and above	O	Outstanding	10	9.5 - 10	First Class with Distinction
85 to below 95	A+	Excellent	9	8.5 - 9.49	
75 to below 85	A	Very good	8	7.5 - 8.49	
65 to below 75	B+	Good	7	6.5 - 7.49	First Class
55 to below 65	B	Satisfactory	6	5.5 - 6.49	
45 to below 55	C	Average	5	4.5 - 5.49	Second Class
35 to below 45	P	Pass	4	3.5 - 4.49	Third Class
Below 35	F	Failure	0	0	Fail
Incomplete	I	Incomplete	0	0	
Absent	Ab	Absent	0	0	

Example- 1 SGPA Calculation

Semester I Course Code	Course Name	Grade Obtained	Grade point (G)	Credit (C)	Credit point (CXG)
xxxxxxxxxx	xxxxxxxxxx	A	8	4	32
xxxxxxxxxx	xxxxxxxxxx	C	5	3	15
xxxxxxxxxx	xxxxxxxxxx	A+	9	4	36
xxxxxxxxxx	xxxxxxxxxx	B+	7	3	21
xxxxxxxxxx	xxxxxxxxxx	P	4	3	12
xxxxxxxxxx	xxxxxxxxxx	C	5	4	20

$$\textbf{SGPA}= \frac{\text{Sum of the Credit points of all courses in a semester}}{\text{Total Credits in that semester}}$$

$$\textbf{SGPA}= \frac{32+15+36+21+12+20}{21} = \frac{136}{21}$$

SGPA= 6.476

Percentage of marks of semester I = (SGPA/10) x 100 = 64.76 %

Note: The SGPA is corrected to three decimal points and the percentage of marks shall be approximated to two decimal points.

Example- 2

Semester II Course Code	Course Name	Grade Obtained	Grade point (G)	Credit (C)	Credit point (CXG)
xxxxxxxxxx	xxxxxxxxxx	A	8	4	32
xxxxxxxxxx	xxxxxxxxxx	C	5	3	15
xxxxxxxxxx	xxxxxxxxxx	A+	9	4	36
xxxxxxxxxx	xxxxxxxxxx	B+	7	3	21
xxxxxxxxxx	xxxxxxxxxx	F	0	3	12
xxxxxxxxxx	xxxxxxxxxx	C	5	4	20

*Failed course

Note: In the event a candidate failing to secure 'P' Grade in any Course in a semester, consolidation of SGPA and CGPA will be made only after obtaining **'P'** grade in the failed Course in the subsequent appearance.

CGPA Calculation

$$\textbf{CGPA}= \frac{\text{Total Credit points obtained in six semesters}}{\text{Total Credits acquired (120)}}$$

$$\textbf{CGPA}= \frac{136 + 145 + 161 + 148 + 131 + 141}{120} = \frac{862}{120}$$

CGPA= 7.183

$$\text{Total percentage of marks} = \frac{\text{CGPA}}{10} \text{ X } 100 = \frac{7.183}{10} \text{ X } 100 = \mathbf{71.83}$$

$$\textbf{CGPA}= \frac{\text{Total Credit points obtained for Core Courses}}{\text{Total Credits acquired for Core Courses}}$$

Similarly CGPA of Complementary courses, Open courses, English Common courses and Additional Language Common courses may be calculated and the respective percentage may be calculated. All these must be recorded in the Final Grade Card.

ANNEXURE II

Guidelines for the Evaluation of Projects

1. PROJECT EVALUATION- Regular

1. Evaluation of the Project Report shall be done under Mark System.
2. The evaluation of the project will be done at two stages:
   a) Internal Assessment (supervising teachers will assess the project and award internal Marks)
   b) External evaluation (external examiner appointed by the College)
   c) Grade for the project will be awarded to candidates, combining the internal and external marks.
3. The internal to external components is to be taken in the ratio 1:4. Assessment of Internal and External assessment are to be done based on the components given below
   - Relevance of the Topic, Statement of Objectives (Total 15 Marks)
   - Methodology (Reference/ Bibliography, Presentation, quality of Analysis/ Use of
   - Statistical Tools) (Total 15 Marks)
   - Findings and recommendations (Total 20 Marks)
   - Project cum Programme Viva Voce (Total 20 Marks)
   - Report of Industrial visit (Total 10 Marks)
4. External Examiners will be appointed by the College from the list of VI Semester Board of Examiners in consultation with the Chairperson of the Board.
5. The Chairman of the VI semester examination board should form the evaluation teams and coordinate their work.
6. Internal Assessment should be completed 2 weeks before the last working day of VI Semester.
7. Internal Assessment marks should be published in the Department Notice Board.
8. In the case of Courses with practical examination, project evaluation shall be done along with practical examinations.
9. The Chairman Board of Examinations, may at his discretion, on urgent requirements, make certain exception in the guidelines for the smooth conduct of the evaluation of project.

PASS CONDITIONS

Submission of the Project Report and presence of the student for viva are compulsory for internal evaluation. No marks shall be awarded to a candidate if she/he fails to submit the

Project Report for external evaluation. The student should get a minimum P Grade in aggregate of External and Internal. There shall be no improvement chance for the Marks obtained in the Project Report.

* In the extent of student failing to obtain a minimum of Pass Grade, the project work may be re-done and a new internal mark may be submitted by the Parent Department. External examination may be conducted along with the subsequent batch.

ANNEXURE III

Question Paper Type 1

Scheme of examinations:

The external QP with 80 marks and internal examination is of 20marks. Duration of each external examination is 2.5 Hours. The pattern of External Examination is as given below. The students can answer all the questions in Sections A&B. But there shall be Ceiling in each section.

Section A

Short answer type carries 2 markseach-15questions Ceiling- 25

Section B

Paragraph/ Problem type carries 5 markseach-8questions Ceiling- 35

Section C

Essay type carries10 marks (2 out of 4) 2x10= 20

Question Paper Type 2

Scheme of examinations:

The external QP with 60 marks and internal examination is of 15marks. Duration of each external examination is 2 Hours The pattern of External Examination is as given below. The students can answer all the questions in Sections A&B. But there shall be Ceiling in each section.

Section A

Short answer type carries 2 markseach-12questions Ceiling-20

Section B

Paragraph/ Problem type carries 5 markseach-7questions Ceiling -30

Section C

Essay type carries 10 marks (1 out of 2) 1x10= 10

The external examination in theory courses is to be conducted with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation and answer keys.

The external examination in practical courses shall be conducted by two examiners, one internal and an external. The project evaluation with Programme viva voce will be conducted by two examiners, one internal and an external (appointed by the University), at the end of the sixth semester. No practical examination will be conducted in odd semester. Practical examinations for BSc Computer Science & Mathematics Programme shall be conducted in the even semester 2, 4 and 6.

The model of the question paper for external examination (lab courses) of 3 Hours duration shall be:

1. **Section A:** One marked question of 30 Marks from Programming Lab Part A is to be attempted (Design Algorithm/ Flowchart/ Interface: 10 Marks, Code: 10 Marks, Result: 10Marks. Total 30 Marks)
2. **Section B:** One marked question of 30 Marks from Programming Lab Part B is to be attempted (Design Algorithm/ Flowchart/ Interface: 10 Marks, Code: 10 Marks, Result: 10Marks. Total 30 Marks)
3. **Section C:** Lab viva voce (Total 10 Marks)
4. **Section D**: Lab Record (Total 10 Marks)

Number of students in one batch for practical examination must be limited to 14.

DISTRIBUTION OF CORE COURSES

	Pattern II (Double Main)		
Semester	**Course**	**Hours**	**Credit**
I	Computer Fundamentals & Programming using C	4	3
	Calculus	4	3
	Basic statistics and Probability	4	3
II	Data Structures and Operating Systems	4	3
	Programming Lab I C & DS	4	4
	Multi Variate and Vector Calculus	4	3
III	Introduction to Data Science	4	4
	Basic Logic, Boolean Algebra and Graph Theory	5	4
	DBMS & Software Engineering	4	3
	Theory of Computation	4	3
	Distribution Theory and Statistical Inference	4	3
	LPP and Applications	4	4
IV	Java Programming	7	4
	Theory of Equations and Complex Numbers	5	4
	Programming Lab II RDBMS & Java	5	4
	Statistical Computing using R	4	3
	Differential Equation	4	3

V	Data Analytics using Python	5	3
	Computer Networks & Mobile Computing	4	3
	Artificial Intelligence	3	2
	Real Analysis	5	4
	Algebra	5	4
	Open Course (Mathematics)	3	3
VI	Image Processing	4	3
	Cloud Computing	4	3
	Programming Lab III Python & MATLAB	3	3
	Numerical Analysis	4	3
	Linear Algebra	4	3
	Elective (Mathematics)	4	3
	Project & viva Voce	2	3

<u>DETAILED BREAK UP OF COURSES IS PRESENTED IN FOLLOWING TABLE</u>

LEGEND	
Item	**Description**
	Credits
E	External Component
I	Internal Component
L	Lecture Hours
P	Practical Hours
T	Total

FIRST SEMESTER

Course	Course Code	Title of the Course	Hours per week			Marks			Credits
			L	P	T	I	E	T	
Common English	JENG1A01T	Common English	4	0	4	15	60	75	3
Common English	JENG1A02T	Common English	5	0	5	20	80	100	4
Addl. Language			4	0	4	20	80	100	4
Core Course A Computer Science	GDCS1B01T	Computer fundamentals & programming using C	2	2	4	15	60	75	3
Core Course B Mathematics	GDMA1B01T	Calculus	4	0	4	15	60	75	3
Core Course B Mathematics	GDMA1B02T	Basic Statistics and Probability	4	0	4	15	60	75	3
TOTAL			23	2	25	100	400	500	20

SECOND SEMESTER

Course	Course Code	Title of the Course	Hours per week			Marks			Credits
			L	P	T	I	E	T	
Common English	JENG2A03T	Common English	5	0	5	20	80	100	4
Common English	JENG2A04T	Common English	4	0	4	15	60	75	3
Addl. Language			4	0	4	20	80	100	4
Core Course A Computer Science	GDCS2B02T	Data Structure & Operating Systems	2	2	4	15	60	75	3
Core Course A Computer Science	GDCS2B03P	Programming Lab I: C &DS	0	4	4	20	80	100	4
Core Course B Mathematics	GDMA2B03T	Multi Variable and Vector Calculus	4	0	4	15	60	75	3
TOTAL			19	6	25	105	420	525	21

THIRD SEMESTER

Course	Course Code	Title of the Course	Hours per week			Marks			Credits
			L	P	T	I	E	T	
General Course A Computer Science	GDCS3A01T	Introduction to Data Science	4	0	4	20	80	100	4
General Course B Mathematics	GDMA3A01T	Basic Logic, Boolean Algebra and Graph Theory	5	0	5	20	80	100	4
Core Course A Computer Science	GDCS3B04T	DBMS & Software Engineering	2	2	4	15	60	75	3
Core Course A Computer Science	GDCS3B05T	Theory of Computation	4	0	4	15	60	75	3
Core Course B Mathematics	GDMA3B04T	Distribution Theory and Statistical Inference	4	0	4	15	60	75	3
Core Course B Mathematics	GDMA3B05T	LPP and Applications	4	0	4	20	80	100	4
TOTAL			23	2	25	105	420	525	21

FOURTH SEMESTER

Course	Course Code	Title of the Course	Hours per week			Marks			Credits
			L	P	T	I	E	T	
General Course A Computer Science	GDCS4A02T	Java programming	5	2	7	20	80	100	4
General Course B Mathematics	GDMA4A02T	Theory of Equations and Complex Numbers	5	0	5	20	80	100	4
Core Course A Computer Science	GDCS4B06P	Programming Lab II: RDBMS & Java	0	5	5	20	80	100	4
Core Course B Mathematics	GDMA4B06P	Statistical Computing using R	4	0	4	15	60	75	3
Core Course B Mathematics	GDMA4B07T	Differential Equation	4	0	4	15	60	75	3
TOTAL			18	7	25	90	360	450	18

FIFTH SEMESTER

Course	Course Code	Title of the Course	Hours per week			Marks			Credits
			L	P	T	I	E	T	
Core Course A Computer Science	GDCS5B07T	Data Analytics using Python	3	2	5	15	60	75	3
Core Course A Computer Science	GDCS5B08T	Computer Networks & Mobile Computing	4	0	4	15	60	75	3
Core Course A Computer Science	GDCS5B09T	Artificial Intelligence	3	0	3	15	60	75	2
Core Course B Mathematics	GDMA5B08T	Real Analysis	5	0	5	20	80	100	4
Core Course B Mathematics	GDMA5B09T	Algebra	5	0	5	20	80	100	4
Open Course (Mathematics)			3	0	3	15	60	75	3
TOTAL			23	2	25	100	400	500	19

SIXTH SEMESTER

Course	Course Code	Title of the Course	Hours per week			Marks			Credits
			L	P	T	I	E	T	
Core Course A Computer Science	GDCS6B10T	Image Processing	4	0	4	15	60	75	3
Core Course A Computer Science	GDCS6B11T	Cloud Computing	4	0	4	15	60	75	3
Core Course A Computer Science	GDCS6B12P	Programming Lab III: Python & MATLAB	0	3	3	20	80	100	3
Core Course B Mathematics	GDMA6B10T	Numerical Analysis	4	0	4	15	60	75	3
Core Course B Mathematics	GDMA6B11T	Linear Algebra	4	0	4	15	60	75	3
Elective Core Course Mathematics		Elective	4	0	4	15	60	75	3
Project	GDCS6B13D GDMA6B12D	Industrial Visit and Project Work	0	2	2	15	60	75	3
TOTAL			20	5	25	110	440	550	21

PROGRAMME OUTCOMES

POs	**PROGRAMME OUTCOMES**
PO01	Apply mathematical concepts and techniques to solve complex problems in computer science, including areas such as discrete mathematics, calculus, linear algebra, and probability.
PO02	Develop and analyze algorithms to solve computational problems and apply algorithmic thinking to design efficient solutions.
PO03	Use the knowledge and skills necessary to support their career in software development, web development, databases, and entrepreneurship in recent trends like data analytics, artificial intelligence, Image processing, Networking, Embedded systems etc.
PO04	An ability to understand the core concepts of computer science and to enrich problem solving skills to analyze, design and implement software-based systems of varying complexity.
PO05	An understanding of professional, ethical, legal, security, and social issues and responsibilities for the computing profession.
PO06	Recognize the need for and develop the ability to engage in continuous learning in the context of technological change.
PO07	An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computational systems in a way that demonstrates comprehension of the trade-offs involved in design choices.
PO08	Design and implement database systems and demonstrate proficiency in managing and querying databases.
PO09	Student will be equipped with mathematical modeling ability, problem solving skills, creative talent, and power of communication necessary for various kinds of employment.
PO10	A student will be able to recall basic facts about mathematics and will be able to display knowledge of conventions such as notations, terminology and will get adequate exposure to global and local concerns that explore them many aspects of mathematical sciences.
PO11	Enable students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

SEMESTER I

GDCS1B01T: COMPUTER FUNDAMENTALS AND PROGRAMMING USING C

Contact Hours per Week	**: 4 (2L + 2P)**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Duration of External examination	**: 2 Hours**

Objectives

- To learn digital fundamentals of computing
- To learn the concept of programming
- To study C Programming language
- To equip the students to write programs for solving simple computing problems

Course Outcomes

- Identifies basics of digital computing
- Develops an in depth understanding of functional and logical concepts of C Programming
- Provides exposure to problem solving through C programming

Module I (8 T)

Features of Digital Systems- Number system- decimal, binary, octal and hexadecimal number, interconversion of decimal to binary and vice versa- Binary arithmetic- Addition and Subtraction, Multiplication, Division, Floating Point, Binary codes- BCD codes, Gray codes, ASCII Code- Basic of Boolean Algebra- Laws, Rules, De-Morgan's theorem -Logic gates- OR, AND, NOT, NAND, NOR, XOR, XNOR- Flip-flops-set-reset laches, D-flipflop, R-S flip-flop.

Module II (8T + 10P)

Introduction to Problem solving- Algorithm- definition, Characteristics, notations. Flowchart- definition, Symbols used in writing the flow-chart Writing an algorithm and flow-chart of simple problems. An overview of Programming languages, Classification, Basic structure of a C Program- character set, tokens, keywords and identifiers. Constants, variables, data types, variable declaration, symbolic constant definition. C operators- Conditional and Unconditional control statements.

Module III (8T + 10P)

Array, types- one and two dimensional array, (definition, declaration, initialization with examples)- Pointers- Pointer arithmetic, Passing pointers as function arguments, Accessing array elements through pointers, Storage classes- fixed vs. automatic duration, Global variables- Structure and Union.

Module IV (8T + 12P)

Functions- definition, need, syntax for function declaration, function prototype, category of functions, nesting of functions, function with arrays, scope of variables, parameter passing mechanism- call by value and call by reference. Recursion and Recursive function.

Strings- definition, declaration and initialization of string variable, string handling functions- strcmp, strcpy, strrev, strlen, strlwr, strupr (explanation with syntax and examples). File Handling: Creating, Processing, Opening and closing a data file.

References

1. 1.Thomas L Floyd, Digital Fundamentals, Universal Book Stall
2. Fundamentals of Computers, V. Rajaraman.
3. Computer Concepts and C Programming, P.B. Kotur
4. Let us C, Yashwanth Kanetkar
5. ANSI C, Balagurusamy

SEMESTER I

GDMA1B01T: CALCULUS

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To introduce students to the fundamental ideas of limit, continuity, and differentiability and to some basic theorems of differential calculus.
- To deal with the other branch of calculus i.e., integral calculus.

Course Outcomes

- To show how these ideas of differential calculus can be applied in the problem of sketching of curves and in the solution of some optimization problems of interest in real life.
- To understand the geometric problem of finding out the area of a planar region and practical way of evaluating the definite integral which establishes the close connection between the two branches of Calculus.
- To find the arc length of a plane curve, volume, and surface areas of solids and so on.
- To use integration as a powerful tool in solving problems in physics, chemistry, biology, engineering, economics, and other fields.

Module I **(15 Hours)**

1.1 Intuitive introduction to Limits- A Real- Life Example, Intuitive Definition of a Limit, One-Sided Limits, Using Graphing Utilities to Evaluate Limits

1.2 Techniques for finding Limits- Computing Limits Using the Laws of Limits, Limits of Polynomial and Rational Functions, Limits of Trigonometric Functions, The Squeeze Theorem.

1.3 Precise Definition of a Limit- $\varepsilon - \delta$ definition of limit, A Geometric Interpretation, Some illustrative examples

1.4 Continuous Functions- Continuity at a Number, Continuity at an Endpoint, Continuity on an Interval, Continuity of Composite Functions, Intermediate Value Theorem

2.1 The Derivatives- Definition only

2.9 Differentials and Linear Approximations- increments, Differentials, Error Estimates, Linear Approximations, Error in Approximating Δy by dy.

Module II **(18 Hours)**

3.1 Extrema of Functions- Absolute Extrema of Functions, Relative Extrema of Functions, Fermat's Theorem**,** Finding the Extreme Values of a Continuous Function on a Closed Interval, An Optimization Problem

3.2 The Mean Value Theorem- Rolle’s Theorem, The Mean Value Theorem**,** Some Consequences of the Mean Value Theorem, Determining the Number of Zeros of a Function.

3.3 Increasing and Decreasing Functions- definition, inferring the behaviour of function from sign of derivative, Finding the Relative Extrema of a Function, first derivative test

3.4 Concavity and Inflection points- Concavity, Inflection Points, The Second Derivative Test, The roles of ‘and *f*’ in determining the Shape of a Graph.

3.5 Limits involving Infinity; Asymptotes- Infinite Limits, Vertical Asymptotes, Limits at Infinity, Horizontal Asymptotes, Infinite Limits at Infinity, Precise Definitions

3.6 Curve Sketching-The Graph of a Function, Guide to Curve Sketching, Slant Asymptotes, Finding Relative Extrema Using a Graphing Utility.

3.7 Optimization Problems- guidelines for finding absolute extrema, Formulating Optimization Problems- application involving several real life problems.

Module III **(16 Hours)**

4.1 Anti derivatives, Indefinite integrals, Basic Rules of Integration, a few basic integration formulas and rules of integration, Differential Equations, Initial Value Problems.

4.3 Area- An Intuitive Look, The Area Problem, Defining the Area of the Region Under the Graph of a Function-technique of approximation [‘Sigma Notation’ and ‘Summation Formulas’ Omitted] An Intuitive Look at Area (Continued), Defining the Area of the Region Under the Graph of a Function-precise definition, Area and Distance.

4.4 The Definite Integral- Definition of the Definite Integral, Geometric Interpretation of the Definite Integral, The Definite Integral and Displacement, Properties of the Definite Integral, More General Definition of the Definite Integral.

4.5 The Fundamental Theorem of Calculus- How Are Differentiation and Integration Related? The Mean Value Theorem for Definite Integrals, The Fundamental Theorem of Calculus: Part I, inverse relationship between differentiation and integration, Fundamental Theorem of Calculus: Part 2, Evaluating Definite Integrals Using Substitution, Definite Integrals of Odd and Even Functions, The Definite Integral as a Measure of Net Change.

Module IV **(15 Hours)**

5.1 Areas between Curves- A Real Life Interpretation, The Area Between Two Curves, Integrating with Respect to -adapting to the shape of the region, What Happens When the Curves Intertwine?

5.2 Volume- Solids of revolution, Volume by Disk Method, Region revolved about the x-axis, Region revolved about the y-axis, Volume by the Method of Cross Sections [‘Washer Method omitted].

5.4 Arc Length and Areas of surfaces of revolution- Definition of Arc Length, Length of a Smooth Curve, arc length formula, The Arc Length Function, arc length differentials, Surfaces of Revolution, surface area as surface of revolution.

Text

1. Calculus: Soo T Tan Brooks/Cole, Cengage Learning (2010).

References

1. Kenneth H, Rosen: Discrete Mathematics and its Applications (7/e) Mc Graw-Hill, NY (2007).
2. Jon Rogawski & Colin Adams: Calculus Early Transcendentals (3/e) W.H. Freeman and Company (2015).
3. Anton, Bivens & Davis: Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc. (2016).
4. Jerrold Marsden & Alan Weinstein: Calculus I and II (2/e) Springer Verlag NY (1985).

SEMESTER I

GDMA1B02T: BASIC STATISTICS AND PROBABILITY

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible & appropriate interpretations
- To derive various descriptive statistics and measures of linear relationship between variables
- To understand basics of excel.

Course Outcomes

- Gives the students introductory level practical ability to choose, generate and properly interpret statistical data using descriptive measures
- Analyze statistical data using MS Excel.

Module I (17 Hours)

Introduction to Statistics: Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics. Concept of primary and secondary data. Designing a questionnaire and a schedule. Concepts of statistical population and sample from a population, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data. Presentation of data by table and by diagrams, frequency distributions by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogives.

Module II (16 Hours)

Measures of central tendency (mean, median, mode, geometric mean and harmonic mean) with simple applications. Absolute and relative measures of dispersion (range, quartile deviation, mean deviation and standard deviation) with simple applications. Co-efficient of variation, Box Plot. Importance of moments, central and non-central moments, and their interrelationships. Measures of skewness based on quartiles and moments; kurtosis based on moments.

Module III (16 Hours)

Correlation and Regression: Scatter Plot, Simple correlation, Simple linear regression, two regression lines, regression coefficients. Fitting of straight line, parabola, exponential, polynomial (least square method).

Module IV **(15 Hours)**

Random experiments sample space and events, Different approaches to probability. Axioms of probability, Conditional probability and independence, Addition and multiplication theorems, Law of total probability and Bayes theorem
(Practical of all sections using excel)

Text

1. S.C. Gupta and V. K. Kapoor Fundamentals of Mathematical Statistics, Sultan Chand and Sons (11th Edition).

References

1. John E Freund, Mathematical Statistics (6th edn.), Pearson Edn., New Delhi.
2. S P Gupta, Statistical Methods, Sultan Chand and Sons.
3. Manisha Nigam, Data analysis with excel, BPB publishers.

SEMESTER II

GDCS2B02T: DATA STRUCTURES & OPERATING SYSTEMS

Contact Hours per Week	**: 4 (2T + 2 P)**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To introduce the concept of data structures
- To make the students aware of various data structures
- To equip the students, implement fundamental data structures
- To learn objectives and functions of operating systems
- To understand process and its life cycle.
- To learn and understand various memory and scheduling algorithms

Course Outcomes

- Understand basic data structures such as arrays, linked lists, stacks and queues.
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
- Students will learn the fundamental components of a computer operating system.
- Understanding CPU Scheduling, Synchronization, Deadlock Handling and Comparing CPU Scheduling Algorithms.
- Describe the role of paging, segmentation and virtual memory in operating systems

Module I (10 L + 10 P)

Data structure- definition- types & operations, characteristics of data structures. Arrays- Introduction, Linear arrays, Representation of linear array in memory, Traversal, Insertions, Deletion, sorting in an array, Searching: sequential searching, binary searching, Sorting: Quick Sort, Exchange sort. Linked List- Introduction, Representation of linked lists in memory, Traversal, Insertion, Deletion, Searching in a linked list, Circular linked list, Two-way linked list. Stack: primitive operation on stack, Representation of Stack in memory, Queue- operations and its representation in memory- circular queue.

Module II (8 L + 12 P)

Trees - Basic Terminology, representation, Binary Trees, Tree Representations using Array & Linked List, Basic operation on Binary tree: insertion, deletion and processing, Traversal of binary trees: In order, Pre-order & post-order. Introduction to graphs, Definition, Terminology, Directed, Undirected & Weighted graph, Representation of graphs, graph traversal- depth-first and breadth-first traversal of graphs.

Module III (14 L)

Operating System- Objectives and functions and- types of operating systems. Process, Process States, Process Control Block, Operations on Process, Process Communication, Process scheduling, Memory Management, Address Binding, Logical Vs Physical Address Space, Overlays, Swapping, Contiguous Memory allocation, Paging, Segmentation, Virtual memory, Demand Paging, Page Replacement.

Module IV (10 L)

CPU Scheduling- types, scheduling algorithms- criteria, nonpreemptive, preemptive. Comparative study of scheduling algorithms- FCFS, SJF, Priority, RR, Multilevel, Feedback Queue. Process synchronization, The Critical Section Problem, Synchronization Hardware.

Text

1. Seymour Lipschutz, "Data Structures", Tata McGraw- Hill Publishing Company Limited, Schaum‟s Outlines, New Delhi.
2. Yedidyan Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, "Data Structures Using C", Pearson Education., New Delhi.
3. Horowitz and Sahani, "Fundamentals of data Structures", Galgotia Publication Pvt. Ltd.
4. Silberschatz, Galvin and Gagne, Operating System Concepts, John Willey & Sons.
5. William Stallings, Operating Systems, Internals and Design Principles, PHI.

References

1. A.K. Sharma, Data Structures Using C, Pearson, Second edition, 2011 4.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley, ISBN: 978-0201000238.
3. Horowitz E and Sahni S, Fundamentals of Data Structures, Computer Science Press, ISBN: 9780716780427.
4. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, ISBN: 0929306406.
5. Richard F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudocode Approach With C, Thomson Brooks/Cole Publications, Course Technology, ISBN: 9780534390808.
6. Nair A.S., Makhalekshmi, Data Structures in C, PHI, Third edition 2011.
7. Nutt G.J, Operating Systems: A Modern Perspective, Addison Wesley.

SEMESTER II

GDCS2B03P: PROGRAMMING LAB I: C AND DS

Contact Hours per Week	**: 4P**
Number of Credits	**: 4**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of Lab examination	**: 2.5 Hours**

Objectives

- To make the students learn programming environments.
- To practice procedural programming concepts.
- To make the students equipped to solve mathematical or scientific problems using C

Part A: C Programming

List of Exercises:

Write programs to do the following:

1. Find the sum of digits and reverse of a number.
2. Find the distance between two points.
3. Find the factorial of a number.
4. Find the Nth Fibonacci number using recursion.
5. Print the reverse of a string using recursion.
6. Solve the problem of Towers of Hanoi using recursion.
7. Find Sin(x) and Cos(x) in the range 0^o to 180^o (interval 30^o) using functions.
8. Create a pyramid using “*“.
9. Display the multiplication tables up to the number N.
10. Find the number of words in a sentence.
11. Perform matrix addition, subtraction, multiplication, inverse, and transpose using pointers and functions.
12. Replace a part of the string with another string.
13. Find the power of a number using structure and union.
14. Find the average of prime numbers in a group of N numbers using function.
15. Find the sum of the series S = 1 + (1⁄2)2+ (1/3)3+ .... to 0.0001% accuracy.
16. Display the rightmost digit in a floating point number.
17. Create a pattern with the number N.

    e.g. N = 39174 Pattern: 3 9 1 7 4

        9 1 7 4
        1 7 4
        7 4
        4
18. Display the short form of a string. E.g. Computer Science: CS
19. Currency conversion (any four currencies)
20. Find the currency denomination of a given amount.

21. Prepare sales bill using array of structures.
22. Addition and subtraction of complex numbers using structure.
23. Find the Armstrong numbers within a given range.
24. Check for palindrome string/number.
25. Check for leap year.
26. Find the number of special characters in a given string.
27. Store and read data from a text file.
28. Write odd and even numbers into separate files.
29. Swapping of two numbers using call-by-reference method.
30. Copy the contents of one file into another one using command line parameters.
31. Base conversion of numbers.
32. Calculate the percentage of marks obtained for N students appeared for examination in M subjects using array of structures.
33. Display a table of the values of function y= exp (-x) for x varying from 0.0 to N in steps of 0.1
34. Design a Scientific Calculator and include as many functions as possible.
35. Merge two numeric arrays in sorted order.
36. Fill upper triangle with 1, lower triangle with -1 and diagonal elements with 0.
37. Count the occurrence of different words in a sentence.
38. Convert an input amount into words.
39. Convert a time in 24 hour clock to a time in 12 hour clock using structure.
40. Change the date/time format using structure.

Part B: Data Structures

Objectives

- To learn how to implement various data structures.
- To provide opportunity to students to use data structures to solve real life problems.
- Theoretical knowledge in Data structures.
- Knowledge in Database

List of Exercises:

1. Sort a given list of strings
2. Reverse a string using pointers.
3. Implement Pattern matching algorithm.
4. Search an element in the 2-dimensional array
5. Append 2 arrays
6. Merge two sorted array into one sorted array.
7. Search an element in the array using iterative binary search.
8. Search an element in the array using recursive binary search.
9. Implement sparse matrix
10. Implement polynomial using arrays
11. Implement singly linked list of integers.
12. Delete a given element from a singly linked list

13. Sort a singly linked list.
14. Delete an element from a singly linked list
15. Implement a doubly linked list of integers
16. Implement a circular linked list.
17. Implement polynomial using linked list
18. Addition of 2 polynomials
19. Implement Stack using array
20. Implement Stack using linked list
21. Infix expression into its postfix expression
22. Implement Queue using array
23. Implement Queue using linked list
24. Implement a binary search tree of characters.
25. Traverse a binary search tree non recursively in preorder
26. Traverse a binary search tree non recursively in inorder
27. Traverse a binary search tree non recursively in postorder
28. Traverse a binary search tree recursively in preorder
29. Traverse a binary search tree recursively inorder
30. Traverse a binary search tree recursively postorder.
31. Delete an element from a binary search tree.
32. Search an element in a binary search tree
33. Implement linear sort
34. Implement bubble sort
35. Implement exchange sort
36. Implement selection sort.
37. Implement insertion sort.
38. Implement quick sort.
39. Implement merge sort.
40. Implement heap sort

SEMESTER II

GDMA2B03T: MULTI VARIABLE AND VECTOR CALCULUS

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To understand the extension of the studies of single variable differential and integral calculus to functions of two or more independent variables. Also, the emphasis will be on the use of Computer Algebra Systems by which these concepts may be analyzed and visualized to have a better understanding.
- This course will facilitate to become aware of applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

Course Outcomes

- Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion.
- Understand the maximization and minimization of multivariable functions subject to the given constraints on variables.
- Learn about inter-relationship amongst the line integral, double and triple integral formulations.
- Familiarize with Green's, Stokes' and Gauss divergence theorems.

Module I **(16 Hours)**

Calculus of Functions of Several Variables

Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Higher order partial derivative, Tangent planes, Total differential and differentiability, Chain rule, Directional derivatives, The gradient, Maximal and normal property of the gradient, Tangent planes and normal lines. (11.1 to 11.6)

Module II **(16 Hours)**

Extrema of Functions of Two Variables and Properties of Vector Field. Extrema of functions of two variables, Method of Lagrange multipliers, Constrained optimization problems; Definition of vector field, Divergence and curl. (11.7, 11.8, 13.1)

Module III **(16 Hours)**

Double and Triple Integrals

Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelopiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals. (12.1 to 12.6)

Module IV **(16 Hours)**

Green's, Stokes' and Gauss Divergence Theorem, Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, Gauss divergence theorem. (13.2 to 13.7)

Text

1. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). Calculus (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.

Reference

1. Marsden, J. E., Tromba, A., & Weinstein, A. (2004). Basic Multivariable Calculus. Springer (SIE). First Indian Reprint.

SEMESTER III

GDCS3A01T: INTRODUCTION TO DATA SCIENCE

Contact Hours per Week	**: 4**
Number of Credits	**: 4**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- Provide a strong foundation for data science and application areas related to it.
- Understand the underlying core concepts and emerging technologies in data science.
- Learn the process of working with data on large scale.
- Explore the concepts of Data Processing.
- Prepare students for advanced courses in Data Science.

Course Outcomes

- Understand the fundamental concepts of data science.
- Evaluate the data analysis techniques for applications handling large data and Demonstrate the data science process.
- Visualize and present the inference using various tools.
- Learn to think through the ethics surrounding privacy, data sharing.

Module I (16T)

Data Evolution: Data to Data Science- Understanding data: Introduction- Type of Data, Data Evolution- Data Sources. Preparing and gathering data and knowledge- Philosophies of data science- Data science in a big data world- Benefits and uses of data science and big data-facets of data.

Module II (16T)

Digital Data- An Imprint: Introduction to Big Data: Evolution of Big Data- What is Big Data-Sources of Big Data. Characteristics of Big Data 6Vs- Big Data- Challenges of Conventional Systems- Data Processing Models- Limitation of Conventional Data Processing Approaches. Big Data Exploration- The Big data Ecosystem and Data science. Overview of the data science process- retrieving data- Cleansing, integrating, and transforming data.

Module III (14T)

First steps in big data- Distributing data storage and processing with frameworks- Case study: Assessing risk when loaning money- Join the NoSQL movement- Introduction to NoSQL-Case Study. The rise of graph databases- Introducing connected data and graph databases.

Module IV (18T)

Ethics and Data Science- Doing Good Data Science, Data Ownership, The Five Cs, Implementing the Five Cs, Ethics and Security Training, Developing Guiding Principles, Building Ethics into a Data- Driven Culture, Regulation, Building Our Future.

Text

1. Introducing Data Science, Davy Cielen, Arno D.B. Meysman and Mohamed Ali, Manning Publications, 2016.
2. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.
3. Ethics and Data Science, Mike Loukides, Hilary Mason and D.J. Patil, O'Reilly, 1st edition, 2018.

Reference

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015.
2. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
3. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.
4. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013**.**

SEMESTER III

GDMA3A01T: BASIC LOGIC, BOOLEAN ALGEBRA AND GRAPH THEORY

Contact Hours per Week	**: 5**
Number of Credits	**: 4**
Number of Contact Hours	**: 80 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- Study about basic logic operators and the operations.
- Study about Boolean algebra and its properties.
- To make an idea about graph theory and about some well known graphs.

Course Outcomes

- Identify correct and incorrect arguments
- Understand the criteria for the evaluation of arguments
- Understand the scientific way of decision making using the laws of logic
- Understand the concept of algebraic structures in Mathematics
- Identify a given algebraic structure as belonging to a particular family of structures and to state the characteristic properties of the members of the family
- Understand the concept of groups and derive basic theorems on groups
- Define the concept of Boolean algebra as an algebraic structure and list its properties
- Understand the applications of Boolean algebra in switching circuits
- Define a Graph and identify different classes of graphs
- Understand various applications of Graph theory

Module I **(20 Hours)**

Text 1

1.1 Propositions- definition, Boolean (logic) variables, Truth Value, Conjunction, Boolean expression, Disjunction (inclusive and exclusive), Negation, Implication, Converse, Inverse and Contra positive, Biconditional statement, Order of Precedence, Tautology Contradiction and Contingency [‘Switching Networks’ omitted].

1.2 Logical equivalences- laws of logic [‘Equivalent Switching Networks’ ‘Fuzzy logic’ & ‘Fuzzydecisions ‘omitted].

1.3 Quantifiers - universal & existential, predicate logic.

1.4 Arguments - valid and invalid arguments, inference rules.

1.5 Proof Methods- vacuous proof, trivial proof, direct proof, indirect proof- contrapositive & contradiction, proof by cases, Existence proof constructive & non constructive, counterexample.

Module II **(20 Hours)**

Text 2

Lattices

14.2 Ordered Sets (Kleene Closure and Order omitted)

14.3 Hasse Diagrams of Partially Ordered Sets

14.4 Consistent Enumeration

14.5 Supremum and Infimum

14.6 Isomorphic (Similar) Ordered Sets

14.7 Well- ordered sets

14.8 Lattices

14.9 Bounded Lattices

14.10 Distributive Lattices

14.11 Complements, Complemented Lattices

Module III **(20 Hours)**

Text 3

Graph Theory

1.1 Definition of a graph

1.2 Graphs as models

1.3 More definitions

1.4 Vertex degrees

1.5 Sub graphs

1.6 Paths and Cycles

1.7 Matrix representation of a graph [up to Theorem 1.6; proof of Theorem 1.5 is omitted]

2.1 Definitions and Simple Properties

2.2 Bridges [Proof of Theorem 2.6 and Theorem 2.9 are omitted]

Module IV **(20 Hours)**

Text 3

2.3 Spanning Trees

2.6 Cut Vertices and Connectivity [Proof of Theorem 2.21 omitted]

3.1 Euler Tour [up to Theorem 3.2, proof of Theorem 3.2 omitted]

3.3 Hamiltonian Graphs [Proof of Theorem 3.6 omitted]

5.1 Plane and Planar graphs [Proof of Theorem 5.1 omitted]

5.2 Euler’s Formula [Proofs of Theorems 5.3 and Theorem 5.6 omitted]

Text

1. Discrete Mathematics with Applications : Thomas Koshy, Elsever Academic Press (2004),
2. Theory and Problems of Discrete Mathematics : Third Edition, Seymour Lipschutz, Marc Lars Lipson, McGraw-Hill Companies
3. A First Look at Graph Theory: John Clark & Derek Allan Holton, Allied Publishers, First Indian Reprint 1995

References

1. Susanna S. Epp: Discrete Mathematics with Applications (4/e), Brooks/ Cole Cengage Learning (2011), ISBN: 978-0-495-39132-6.
2. Kenneth H. Rosen: Discrete Mathematics and Its Applications (7/e), McGraw-Hill, NY (2007), ISBN: 978-0-07-338309-5.
3. R.J. Wilson: Introduction to Graph Theory, 4th ed., LPE, Pearson Education.
4. J.A. Bondy & U.S.R. Murty: Graph Theory with Applications.
5. J. Clark & D.A. Holton: A First Look at Graph Theory, Allied Publishers.
6. N. Deo: Graph Theory with Application to Engineering and Computer Science, PHI.

SEMESTER III

GDCS3B04T: DBMS & SOFTWARE ENGINEERING

Contact Hours per Week	**: 4 (2T + 2P)**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To learn the basic principles of database, database design and DBMS.
- To learn the concepts of database manipulation SQL and PL/SQL.
- To learn engineering practices in Software development, various software design methodologies and practices.
- To learn and study various Testing and Evaluation methods in Software Development.

Course Outcomes

- Students will have a broad understanding of database concepts and database management system software.
- Be able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
- Improve the database design by normalization and be able to write SQL/PL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS.
- Students will be able to decompose the given project in various phases of a lifecycle.

Module I

Database System concepts: Schemas, and Instances, Three Schema Architecture and Data Independence and types, ER data model- basic concepts, constraints, keys, ER diagram. Relational Database Design: Anomalies in a Database, Normalization Theory, Functional Dependencies, Multivalued dependencies and join dependencies, Normal Forms.
Transaction processing and concurrency control: Definition of Transaction, ACID properties, Transaction Processing states. Concurrency Control- Locks: Two phase locking protocols.

Module II

SQL- SQL Concepts: Basics of SQL, DDL, DML, DCL, Tables- Create, Modify and Delete table structures, Rename and Drop tables, Defining constraints- Primary key, foreign key, unique, notnull, check, IN operators, Select Command, Logical Operators, Functions- aggregate functions, Use of group by, having, order by.

Module III

Software and Software Engineering: Overview of Software Engineering, Software Process, SDLC, Prescriptive process model- Waterfall Model, Spiral Model, Incremental Process

Model. Agile development- Agile Process; Extreme Programming; Other Agile Process Models- ASD, Scrum, DSDM, LSD.

Module IV

Modelling with UML: Concepts and Diagrams- Use Case Diagrams- Class Diagrams- Interaction Diagrams- State chart diagram. Testing and maintenance: Software Quality- Testing types- Unit testing, Integration testing, UAT, System testing. Black box and White box testing. Software Reengineering. Maintenance: definition and it's types.

Text

1. Abraham Silberschatz, Henry F Korth, S.Sudharshan, Database System Concepts, 6th Edition.
2. Roger S, “Software Engineering- A Practitioner’s Approach”, seventh edition, Pressman, 2010.
3. Pearson Education, “Software Engineering by Ian Sommerville”, 9th edition, 2010.
4. Roff: UML: A Beginner’s Guide TMH.

References

1. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson.
2. Abraham Silbersehatz, Henry F. Korth and S. Sudarshan, Database System Concepts, 6th Edition, Tata McGraw-Hill.
3. Vikram Vaswani, MySQL The complete Reference, 1st Edition, Tata Mcgraw Hill Education Private Limited.
4. Paul Nielsen, Microsoft SQL Server 2000 Bible, Wiley Dreamtech India Pubs.
5. Ramkrishnan, Database Management Systems, Mc Graw Hill.

SEMESTER III

GDCS3B05T: THEORY OF COMPUTATION

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To get a general introduction to the theory of Computer Science
- To get a general understanding on different languages, grammar and automata

Course Outcomes

- Examine the properties of formal language and automata, their equivalence and be familiar with Regular and Non regular Language and Finite automata.
- On successful completion of the course, the student will be familiar with Turing machines
- Understand the concept of Context Free Grammars and Pushdown Automata.
- Conversion techniques.
- Understand Tractable and Intractable Problems

Module I (12T)

Formal languages: Definitions and examples, Chomsky classification of languages, Languages and their relation, Recursive and Recursively enumerable sets, Languages and automata.

Module II (18T)

Theory of Automata: Definition of automaton, description of a finite automaton, DFA, transition systems, properties of transition functions, acceptability of a string by a finite automaton, Non deterministic finite state machines: with epsilon moves and without epsilon moves, equivalence of DFA and NDFA, Mealy and Moore Models, minimization of finite automata. Regular sets and grammar: Regular expressions, Finite automata and regular expressions, closure properties of regular sets, Algebraic laws for regular expressions, regular sets and regular grammars.

Module III (20T)

Context free languages: Context free languages and derivation trees, Ambiguity in context free grammars, Simplification of context free languages, normal forms for context free languages.

Module IV (20T)

Pushdown automata: Definition, Acceptance by PDA, Pushdown automata and Context-free languages, Parsing and Pushdown Automata. Turing Machines: Turing machine model, representation of Turing machines, languages accepted by Turing machine**.**

Text

1. Theory of Computer Science- Automata, Languages and Computation- K.L.P. Mishra, N Chandrasekaran, PHI
2. Theory of Computation, Sachin Agrawal, Vikas Publishing House

References

1. Introduction to Automata Theory, Languages & Computations, J.E. Hopcroft, R. Motwani & J. D. Ullman
2. Elements of theory of Computation, Second edition, H.R. Lewis and C.H. Papadimitriou, Pearson education.
3. An Introduction to the Theory of Computer Science, Languages and Machines- Thomas A. Sudkamp, Third Edition, Pearson Education.
4. An Introduction to Formal languages and Automata- Peter Linz.

SEMESTER III

GDMA3B05T: LPP AND APPLICATIONS

Contact Hours per Week	**: 4**
Number of Credits	**: 4**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- To get a general introduction in solving linear programming problems.
- To get a general understanding of network analysis technique.
- To get a general understanding of different mathematical models

Course Outcomes

- Study different methods to solve Linear Programming Problems.
- Study to convert real life problems as mathematical models
- Students experience the classical way of doing and enjoying mathematics in a much more logical way

Module I **(10 Hours)**

Chapter 1 Geometric Linear Programming: Profit Maximization and Cost Minimization, typical motivating examples, mathematical formulation, Canonical Forms for Linear Programming Problems, objective functions, constraint set, feasible solution, optimal solution, Polyhedral Convex Sets, convex set, extreme point, theorems asserting existence of optimal solutions, The Two Examples Revisited, graphical solutions to the problems, A Geometric Method for Linear Programming, the difficulty in the method, Concluding Remarks

Module II **(20 Hours)**

Chapter 2 The Simplex Algorithm: Canonical Slack Forms for Linear Programming Problems; Tucker Tableaus, slack variables, Tucker tableaus, independent variables or non basic variables, dependent variables or basic variables. An Example: Profit Maximization, method of solving a typical canonical maximization problem, The Pivot Transformation, The Pivot Transformation for Maximum and Minimum Tableaus, An Example: Cost Minimization, method of solving a typical canonical minimization problem, The Simplex Algorithm for Maximum Basic Feasible Tableaus, The Simplex Algorithm for Maximum Tableaus, Negative Transposition; The Simplex Algorithm for Minimum Tableaus, Cycling, Simplex Algorithm Anti cycling Rules, Concluding Remarks.

Module III **(16 Hours)**

Chapter 4 Duality Theory: Duality in Canonical Tableaus, The Dual Simplex Algorithm, The Dual Simplex Algorithm for Minimum Tableaus, The Dual Simplex Algorithm for

Maximum Tableaus, Matrix Formulation of Canonical Tableaus ,The Duality Equation, The Duality theorem, Concluding Remarks.

Module IV **(18 Hours)**

Chapter 6 Transportation and Assignment Problems: The Balanced Transportation Problem, The Vogel Advanced-Start Method (VAM), The Transportation Algorithm, Another Example, Unbalanced Transportation Problems, The Assignment Problem, The Hungarian Algorithm, Concluding Remarks, The Minimum-Entry Method, The Northwest-Corner Method.

Text

1. Linear Programming and Its Applications: James K. Strayer Under- graduate Texts in Mathematics Springer (1989) ISBN: 978-1-4612-6982-3

References

1. Robert J. Vanderbei: Linear Programming: Foundations and Extensions (2/e) Springer Science + Business Media LLC (2001) ISBN: 978-1-4757-5664-7
2. Frederick S Hiller, Gerald J Lieberman: Introduction to Operation Research (10/e) McGraw-Hill Education, 2 Penn Plaza, New York (2015) ISBN: 978-0-07-352345-3
3. Paul R. Thie, G. E. Keough: An Introduction to Linear Programming and Game Theory (3/e) John Wiley and Sons, Ins. (2008) ISBN: 978-0-470-23286-6
4. Louis Brickman: Mathematical Introduction to Linear Programming and Game Theory UTM, Springer Verlag, NY (1989) ISBN: 0-387-96931-4
5. Jiri Matoušek, Bernd Gartner: Understanding and Using Linear Programming Universitext, Springer-Verlag Berlin Heidelberg (2007) ISBN: 978-3-540-30697-9

SEMESTER III

GDMA3B04T: DISTRIBUTION THEORY AND STATISTICAL INFERENCE

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To understand the applications of theoretical discrete distributions
- To equip the students with the theory essential for estimation of unknown parameters and testing of statistical hypotheses.
- Understand various sampling distributions and the related concepts, criteria of good estimators and interval estimation.

Course Outcomes

- Ability to handle transformed random variables and derive associated distributions
- Knowledge of important continuous distributions such as Uniform, Normal, Exponential and Gamma and relations with some other distributions
- A fundamental understanding of Parametric models for developing relevant inferences on associated parameters, knowledge of point and interval estimation procedures and different methods of point estimation

Module I **(15 Hours)**

Random Variables and their probability distributions- Discrete and Continuous Random Variables, Probability Mass Function and probability density function, distribution function and it's properties, bivariate random variables and their joint distribution, conditional distribution

Module II **(15 Hours)**

Mathematical expectations Definition, raw and central moments(definition and relationships), moment generation function and properties, characteristic function (definition and use only), Skewness and kurtosis using moments , Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

Module III **(17 Hours)**

Standard distributions: Discrete type-Bernoulli, Binomial, Poisson, Geometric (definition, properties and applications), Uniform (mean, variance and mgf), Negative Binomial (definition only), Continuous type- Uniform, exponential and Normal (definition, properties and applications); Gamma (mean, variance, mgf); Lognormal, Beta, Pareto and Cauchy (Definition only).

Module IV **(17 Hours)**

Sampling distributions: Statistic parameter, Standard error, statistical inference , point and interval estimation(concept only), Testing of Hypothesis: Level of significance, Null and Alternative hypotheses, simple and composite hypothesis ,Types of Errors, Critical Region, Level of Significance, Power and p-values. Most powerful tests, Test for single mean, equality of two means, Test for single proportion, equality of two proportions. Small sample tests: t-test for single mean, unpaired and paired t-test, F- test, Chi-square test for independence, One Way ANOVA

Text

1. Rohatgi V.K. and Saleh A.K. (2009) Introduction to probability and statistics Wiley India.

References

1. George Casella and Roger Berger (2012) Statistical Inference Wadsworth and Brooks, California.
2. S.C. Gupta and V. K. Kapoor Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. John E Freund, Mathematical Statistics (6th edition), Pearson Edition, New Delhi.

SEMESTER IV

GDCS4A02T: JAVA PROGRAMMING

Contact Hours per Week	**: 7 (5L + 2P)**
Number of Credits	**: 4**
Number of Contact Hours	**: 112 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- To review on concept of OOP.
- To learn Java Programming Environments.
- To practice programming in Java.
- To learn GUI Application development in JAVA.

Course Outcomes

- Knowledge in OOP &basic concepts of Java Programming
- Develop reusable programs using the concepts of Inheritance, Polymorphism, Interfaces and packages.
- Apply the concepts of multithreading and exception handling to develop efficient and error free codes.
- Design event driven GUI and web related applications.

Module I

Introduction to OOPS, Characteristics of OOPS, Object oriented languages, comparison between Procedural and object- oriented programming, basic principles of Object Orientation- class, object, Abstraction, encapsulation, inheritance, polymorphism, modularity, and message passing. Features of object orientation- attributes, state, identity, operation, behaviour. Introduction to Java: History, Versioning, The Java Virtual Machine, Byte code.

Module II

Language Components: Primitive Data Types, Comments, Keywords, literals, Operators, Loops, The break and continue Statement, Casts and Conversions, Arrays. Keyboard Input Using a Buffered Stream. Introduction to classes and methods, constructors, Passing Objects to Methods, Method Overloading, Static and final, The ‘this’ Reference, finalize. Inheriting Class, extends, super keyword. Dynamic method dispatch, method overriding, abstract class, interface, packages, import statement. Exceptions, Threads and I/O: Exception Handling, The Exception Hierarchy, throws statement, throw statement, Developing user defined Exception Classes- The finally Block.

Module III

Threads: Threads vs. Processes, Creating Threads by Extending Thread, Creating Threads by Implementing Runnable, Advantages of Using Threads, Daemon Threads, Thread States,

Thread Problems, Synchronization. Events and GUI Applications: Event Handling: The Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter Classes.
Introduction to the AWT, Overview of the AWT, Structure of the AWT, The AWT hierarchy, Simple Graphics- Point, line, Rectangle, Polygon, Controls- Button, Checkbox, Choice, Label, List, Scroll bar, Text Area, Text Field, Layout Manager, Menu Bar, Menu, Menu Item, Checkbox Menu Item.

Module IV

Applets: Types of Applet, Applet Skeleton, Update method, repaint Methods, Html Applet tag and passing parameter to applet. Database Connectivity & Applets: Introduction to JDBC: The JDBC Connectivity Model, Database Programming, Connecting to the Database, Creating a SQL Query, Executing SQL Queries, Getting the Results, Updating Database Data, Executing SQL Update/ Delete, The Statement Interface, The Result Set Interface, Result Set Meta Data. Introduction to JSP and Java servlet: Features, Advantages, Comparison.

Text

1. Herbert Scheldt, Java The Complete Reference, 8th Edition, Tata McGraw-Hill Edition, ISBN: 9781259002465

References

1. E Balaguruswamy, Programming in Java: A Primer, 4th Edition, Tata McGraw Hill Education Private Limited, ISBN: 007014169X.
2. Kathy Sierra, Head First Java, 2nd Edition, Shroff Publishers and Distributors Pvt Ltd, ISBN: 8173666024.
3. David Flanagan, Jim Farley, William Crawford and Kris Magnusson, Java Enterprise in a Nutshell: A Desktop Quick Reference, 3rd Edition, O'Reilly Media, ISBN: 0596101422.

SEMESTER IV

GDMA4A02T: THEORY OF EQUATIONS AND COMPLEX NUMBERS

Contact Hours per Week	**: 5**
Number of Credits	**: 4**
Number of Contact Hours	**: 80 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Module I Text (1) (20 Hours)

Chapter II (Text 1)

II.1 Integral rational functions or polynomials.

II.2 Multiplication of polynomials.

II.3 Division of polynomials, quotient and remainder, method of detached coefficients

II.4 The remainder theorem

II.5 Synthetic Division

II.6 Horner's process

II.7 Taylor formula, expansion of a polynomial in powers of $x - c$

II.8 Highest common divisor of two polynomials

Chapter III Text (1)

III.1 Algebraic equations, roots, maximum number of roots

III.2 Identity theorem

III.3 The Fundamental theorem of Algebra (statement only), factorisation to linear factors, multiplicity of roots

III.4 Imaginary roots of equations with real coefficients

III.5 Relations between roots and coefficients

III.6 Discovery of multiple roots

Module II Text (1) (20 Hours)

IV.1 Limits of roots

IV.2 Method to find upper limit of positive roots

IV.3 Limit for moduli of roots [only the method to find out upper limit from the auxiliary equation is required; derivation omitted]

IV.4 Integral roots

IV.5 Rational roots

Chapter V Text (1)

V.1 What is the solution of an equation?

V.2 Cardan's formulas

V.3 Discussion of solution

V.4 Irreducible case

V.5 Trigonometric solution

V.6 Solutions of biquadratic equations, Ferrari method [example2 omitted]

Module III Text (1) (20 Hours)

Chapter VI Text (1)

VI.1 Object of the Chapter

VI.2 The sign of a polynomial for small and large values of variables- locating roots of polynomial between two numbers having values of opposite sign- geometric illustration only-[rigorous reasoning in the starred section omitted]

VI.4 Corollaries- roots of odd and even degree polynomial, number of roots in an interval counted according to their multiplicity

VI.5 Examples

VI.6 An important identity and lemma [derivation not needed]

VI.7 Rolle's Theorem [proof omitted], use in separating roots

VI.10 Descarte's rule of signs-only statement and illustrations are required Chapter XI (Text 1)

XI.1 Symmetric Functions- definition, sigma functions, elementary symmetric functions

XI.4 Practical Methods- representation of symmetric functions through elementary symmetric functions.

Module IV Text (2) (20 Hours)

1.1 Complex numbers and their properties- definition, arithmetic operations, conjugate, inverses, reciprocal

1.2 Complex Plane- vector representation, modulus, properties, triangle inequality

1.3 Polar form of complex numbers- polar representation, principal argument, multiplication and division, argument of product and quotient, integer powers, de Moivre's formula.

1.4 Powers and roots- roots, principal nth root

1.5 Sets of points in the complex plane- circles, disks and neighbourhoods, open sets, annulus, domains, regions, bounded sets

2.1 Complex Functions- definition, real and imaginary parts of complex function, complex exponential function, exponential form of a complex number, Polar Coordinates

2.2 Complex Functions as mappings- complex mapping, illustrations, Parametric curves in complex planes, common parametric curves, image of parametric curves under complex mapping[The subsection 'Use of Computers' omitted]

2.3 Linear Mappings- Translations, Rotations, Magnifications, general linear mapping, image of geometric shapes under linear map.

2.4 Special Power functions- The power function z^n, The power function $z^{\frac{1}{n}}$, principal squareroot function, Inverse Functions, multiple valued functions

Text

1. Theory of Equations: J.V. Uspensky McGraw Hill Book Company, Inc. ISBN: 07-066735-7
2. Complex Analysis A First Course with Applications (3/e): Dennis Zill & Patric Shanahan Jones and Bartlett Learning (2015).

References

1. Dickson L.E.: Elementary Theory of Equations John Wiley and Sons, Inc. NY (1914)
2. Turnbull H.W.: Theory of Equations (4/e) Oliver and Boyd Ltd. Edinburg (1947).
3. Todhunter I.: An Elementary Treatise on the Theory of Equations (3/e) Macmillan and Co. London (1875).
4. William Snow Burnside and Arthur William Panton: The Theory of Equations with An Introduction to Binary Algebraic Forms Dublin University Press Series (1881).
5. James Ward Brown, Ruel Vance Churchill: Complex variables and applications (8/e), McGraw-Hill Higher Education, (2009).
6. Alan Jeffrey: Complex Analysis and Applications (2/e), Chapman and Hall/CRC Taylor Francis Group (2006).
7. Saminathan Ponnusamy, Herb Silverman: Complex Variables with Applications Birkhauser Boston (2006) ISBN: 0-8176-4457-4.
8. John H. Mathews & Russell W. Howell: Complex Analysis for Mathematics and Engineering (6/e).
9. H A Priestly: Introduction to Complex Analysis (2/e), Oxford University Press, (2003).
10. Jerrold E Marsden, Michael J Hoffman: Basic Complex Analysis (3/e) W.H Freeman, N.Y. (1999).

SEMESTER IV

GDCS4B06P: PROGRAMMING LABORATORY II: RDBMS AND JAVA

Contact Hours per Week	**: 5**
Number of Credits	**: 4**
Number of Contact Hours	**: 80 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Part A: DBMS- Lab Questions

1. Create a table employee with fields (Emp ID, E Name, Salary, Department, Age). Insert some records. Write SQL queries using aggregate functions for A. Display the total number of employees. B. Display the age of the oldest employee of each department. C. Display departments and the average salaries D. Display the lowest salary in employee table E. Display the highest salary in sales department.

2. A trading company wants to keep the data of their Order Processing Application using the following relations.
Customer_Master
Customer_Number- Primary Key
Customer_Name- Not NULL
Address-
Pincode-
Order_Master
Order_Number- Primary Key
Order_date- Not NULL
Customer_Number- Refers Customer_master table
Order_amount- Not NULL
Order_Detail
Line_Number- Primary Key
Order_Number- Primary Key
Item_No- Not NULL, Refers ITEM table
Quantity- Not NULL
ITEM
Item_No- Primary Key
Unit_Price- Not NULL
SHIPMENT
Order_Number- Primary Key
Warehouse_No- Primary Key, Refers Warehouse table
Ship_Date- Not NULL with Integrity Check
WAREHOUSE
Warehouse_No- Primary Key
City- Not NULL

A. Create the above tables by properly specifying the primary keys and foreign keys.
B. Enter at least five tuples for each relation.
C. Produce a listing: Cust_Name, No_of_orders, Avg_order_amount, where the middle column is the total number of orders by the customer and the last column is the average order amount for that customer.
D. List the Order_Number for orders that were shipped from all the warehouses that the company has in a specific city.
E. Demonstrate the deletion of an item from the ITEM table and demonstrate a method of handling the rows in the ORDER_ITEM table that contains this particular item.

3. In this session you need to create database for an Employee management system of an ABC organization. The details about different tables are given below. According to that you can proceed further and create tables using PostgreSQL/MySQL.
Create the following tables with the specified constraints:

Department
Department Number- Primary Key
Department Name- Not NULL unique
Manager ID- Refers to Employee ID of employee table.
Manager Date of Joining- Not NULL

Employee
First Name- Not NULL
Middle Initials Last Name- Not NULL
Employee ID- Primary Key
Date of Birth- Not NULL
Address Gender- M or F
Salary- Range of 5000 to 25000
Date of Joining Department Number- Refers to Department Number of Department table.

Department location
Department Number- Refers to Department number of department table.
Department Location- Not NULL
Department number & Department location are combined Primary Key

Project
Project Name- Not NULL
Project Number- Primary Key
Project Location- Not NULL
Department number- Refers to department number of Department table.

Works-on
Employee ID- Not NULL refers to Employee ID of Employee table.
Project Number- Not NULL refers to Project number of Project table.
Hours- Not NULL.
Employee ID & Project Number are combined primary key.

Dependent
Employee ID- Refer to employee table Employee ID field
Dependent Name- Gender- M or F

Date of Birth- Not NULL
Relationship- Not NULL
Now enter a few sets of meaningful data and answer the following queries.

A. List the department wise details of all the employees.
B. Find out all those departments that are located in more than one location.
C. Find the list of projects.
D. Find out the list of employees working on a project.
E. List the dependents of the employee whose employee id is 001

4. These sessions is similar to the previous one, but in this session, assume that you are developing a prototype database of the College library management system, for that you need to create the following tables:

- Book Records
- Book details
- Member details and
- Book issue details

Book Records
Accession Number
ISBN Number

Books
ISBN Number
Author
Publisher
Price

Members
Member ID
Member Name
Maximum Number of books that can be issued
Maximum Number of days for which book can be issued

Book Issue
Member ID
Accession Number
Issue Date
Return Date

You must create constraints, including referential integrity constraints, as appropriate. Please note accession number is unique for each book. A book, which has no return date, can be considered as issued book. Enter suitable data into the tables. Now answer the following:

A. Insert data in all the three tables (use insert).
B. Insert appropriate description associated with each table and the column (use comment).
C. Display the structure of the tables.
D. Display the comments that you have inserted.
E. Using SELECT statement, write the queries for performing the following function:
   a) Get the list of all books (No need to find number of copies).
   b) Get the list of all members.

c) Get the Accession number of the books which are available in the library.
d) On return of a book by a member calculate the fine on that book.
e) List of books issued on 01-Jan-2005.
f) Get the list of all books having price greater than Rs. 500/-
g) Get the list of members who did not have any book issued at any time.
h) Get the list of members who have not returned the book.
i) Display member ID and the list of books that have been issued to him/her from time to time.
j) Find the number of copies of each book (A book accession number would be different but ISBN number would be the same).
k) Find the number of copies available of a book of given ISBN number.
l) Get the member ID and name of the members to whom no more books can be issued, because they have already got as many books issued as the number for which they are entitled.

5. This session is based on Lab 2 where you have created a library management system. In this session you have different query specification. You must create appropriate forms, reports, graphs, views and data filtering, use of multilevel report, etc. to answer these queries.

A. Get the list of ISBN- Number, Book name, available copies of the books of which available copies are greater than zero.
B. Get the list of ISBN- Number, Book name, Total copies, available copies of the book of which available copies are greater than zero. List should be displayed in alphabetical order of book name.
C. Get the list of ISBN- number, Book name, Author, total copies, cost (cost is price total copies). List should be displayed in descending order of cost.
D. Get the list of books issued to each member.
E. Write query to know the maximum and average price of the books.
F. Get the list of all existing members and the number of days for which a member is allowed to keep the book. Also find out the members who have got the maximum number of books issued.
G. Get the list of member codes of those members who have more than two books issued.
H. Find the details of the books presently issued to a member.
I. Create the history of issue of a book having a typical accession number.
J. To set the width of the book name to 35.

6. Create the following table and perform the necessary tasks defined below one by one. You must use the query tools/ SQL/ Reports/ Forms/ Graphs/Views/ using client/server wherever needed.

1. Create the following table named customer

Column Name	Type	Size
Customer ID	Character	10
Name	Character	25
Area	Character	3
Phone	Numeric	7

Insert the appropriate data into table and do the following.

- Update Phone numbers of all customers to have a prefix as your city STD Code
- Print the entire customer table
- List the names of those customers who have e as second letter in their names.
- Find out the Customer belonging to area “abc”
- Delete record where area is NULL.
- Display all records in increasing order of name.
- Create a table temp from customer having customer-id, name, and area fields only
- Display area and number of records within each area (use GROUP by clause)
- Display all those records from customer table where name starts with a or area is “abc”.
- Display all records of those where name starts with “a” and phone exchange is 55.

7. Answer the following queries using Library system as created earlier. You must create a view to know member name and name of the book issued to them, use any inbuilt function and operators like IN, ANY, ALL, EXISTS.

a. List the records of members who have not been issued any book using EXISTS operator.
b. List the members who have got issued at least one book (use IN/ ANY operator).
c. List the books which have maximum Price using ALL operator.
d. Display Book Name, Member Name, and Issue date of Book. Create a view of this query of the currently issued books.

8. Create a table of Employee (emp_number, name, dept_number, salary) and Department (dept_ number, dept_name). Insert some records in the tables through appropriate forms having integrity checks. Add some records in employee table where department value is not present in department table. Now answer the following query:

a. Display all records from employee table where department is not found in department table.
b. Display records from employee table in a report format with proper headings. This report must also contain those records where department number does not match with any value of department table.
c. Display those employee records who have salary less than the salary of person whose emp_number= A100.
d. Create another table: Sales Data (Region Code, City, Salesperson Code, Sales Qty).
e. Display records where salesperson has achieved sales more than average sales of all sales persons of all the regions

9. Create the following tables:
Order party: (Order number, Order date, customer code)
Order: Order number, Item code, Quantity The key to the second table is order-number + item-code Create a form for data entry to both the tables.

10. Create a table shop with fields Item_ID, Item_Name, Price, and Quantity. Write a procedure 'sales' to update the quantity by accepting Item_ID and Quantity as argument. Write PostgreSQL block to invoke the procedure.

11. Implement student information system

12. SQL scripts to display various reports like Result of an Examination, Salary Report, Sales Report, Sales reports grouped on Sales person or item, etc

13. Write simple PostgreSQL anonymous blocks for displaying whole numbers from 1 to

100, odd numbers from 1 to 100, even numbers from 1 to 100, positive whole numbers up to a given number, odd numbers from 1 to a given number, even numbers from 2 to a given number, Fibonacci numbers up to 100, Strange numbers up to 1000, factorials of the numbers from 1 to 10, etc.

14. Create a table product with the fields (Product_code primary key, Product_Name, Category, Quantity, Price). Insert some records Write the queries to perform the following.

a. Display the records in the descending order of Product_Name
b. Display Product_Code, Product_Name with price between 20 and 50
c. Display the Product_Name and price of categories bath soap, paste, washing powder
d. Display the product details whose Quantity less than 100 and greater than 500
e. Display product names starts with 's'
f. Display the products which not belongs to the category 'paste'
g. Display the product names whose second letter is 'a' and belongs to the Category 'washing powder'

15. Create a STUDENT table with following fields:

Field Name	Type	Width
Reg. No.	Character	10
Name	Character	20
Paper 1	Numeric	3
Paper 2	Numeric	3
Paper 3	Numeric	3
Paper 4	Numeric	3
Paper 5	Numeric	3
Total	Numeric	3
Result	Character	6
Grade	Character	1

Enter the Reg. No., Name and Marks in 5 Papers of at least 10 students. Write a SQL program to process the records to update the table with values for the fields Total (Paper1+Paper2+Paper3+Paper4+Paper5), Result ("Passed" if total is greater than or equal to 50% of the total; „Failed" otherwise), and Grade ("A" if mark obtained is greater than or equal to 90% of the total mark, „B" if mark obtained is greater than or equal to 75% of the total mark, "C" if mark obtained is greater than or equal to 60% of the total mark, "D" if mark obtained is greater than or equal to 50% of the total mark, and "F" if mark obtained is less than 50% of the total mark). Display a report in descending order of the total mark, showing the data entered into the table along with the total marks, result and grade.

16. An examination has been conducted to a class of 10 students and 4 scores of each student have been provided in the data along with their reg_no, name, total and avg_score. Assign null values to the fields total and average. Write Postgresql block to do the following.

Find the total and average of each student. Update the table with the calculated values Assign a letter grade to each student based on the average Score as:

avg_score between 90 and 100 - A
avg_score 75 -89 - B
avg_score 60- 74 - C
avg_score 50 -59 - D
avg_score below 50 - Failed

17. Prepare a salary report of the employees showing the details such as: Emp No, Name, Basic Pay, DA, Gross Salary, PF, Net Salary, Annual Salary and Tax For this purpose, create a table named SALARIES having the following structure.

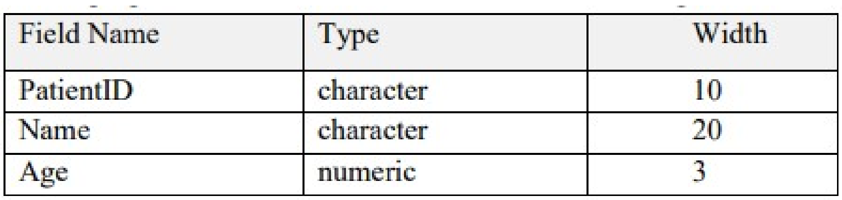
Field Name	Type	Width
Emp. No.	Character	10
Name	Character	20
Basic	Numeric	6

Enter the records of at least 10 employees. Use the following information for calculating the details for the report: DA is fixed as the 40% of the basic pay. PF is fixed as 10% of the basic pay. Gross Salary is (Basic Pay + DA). Net Salary is (Gross Salary – PF) Annual Salary is (12 * Net Salary).
Tax is calculated using the following rules:

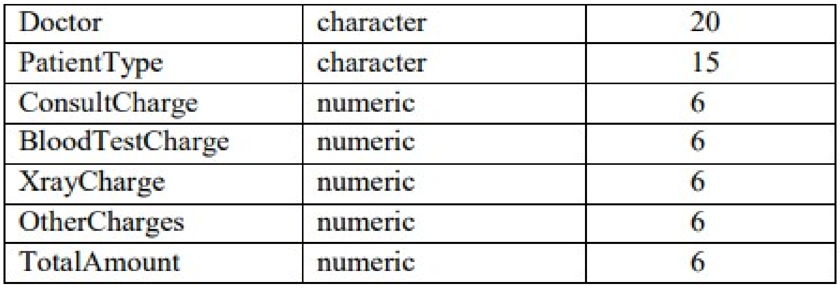
If annual salary is less than 100000, No Tax
If annual salary is greater than 100000 but less than or equal to 150000, then the tax is 10% of the excess over 100000.
If annual salary is greater than 150000 but less than or equal to 250000, then the tax is 20% of the excess over 150000.
If annual salary is greater than 250000, then the tax is 30% of the excess over 250000.

18. Generate a Hospital information system that can generate the following reports:

- Patients who belongs to in-patient category
- Patients who belongs to out-patient category
- For this purpose, create a table named HOSPITAL having the following structure.



Field Name	Type	Width
PatientID	character	10
Name	character	20
Age	numeric	3



Doctor	character	20
PatientType	character	15
ConsultCharge	numeric	6
BloodTestCharge	numeric	6
XrayCharge	numeric	6
OtherCharges	numeric	6
TotalAmount	numeric	6

Enter the records of at least 10 patients. Write a SQL program to display the report in the ascending order of patient name.

19. Using the Hospital table created in Lab 16, generate a Hospital information system that can generate the following reports:

- Patients undergone blood test.
- Patients who have taken X-Rays

20. Design a Hotel Bill calculating system that generates hotel bills for the customers.

21. Design an Electricity Bill Report generating system that generates electricity bills details of customers for a month.

22. Generate a Library Information System that generates report of the books available in the library.

PART B: JAVA PROGRAMMING

1. Write a program to find the distance between two points.
2. Write a program to find the sum, difference, product, quotient and remainder of two numbers passed as command line argument.
3. Write java program to display Fibonacci series up to a limit.
4. Write java program to display Armstrong numbers within a range.
5. Given the sides of a triangle, write a program to check whether the triangle is equilateral, isosceles or scalene and find its area.
6. Read an array of 10 or more numbers and write a program to find the
   a) Smallest element in the array
   b) Largest element in the array
   c) Second largest element in the array
7. Write a program to perform base conversion
   a) Integer to binary
   b) Integer to Octal
   c) Integer to Hexadecimal
8. Write a program to verify De Morgan’s Law
9. Write a program to merge two arrays.
10. Write a program to find the trace and transpose of a matrix.
11. Write java program to find the sum of the digits and reverse of a given number using class and objects.
12. Write a program to sort a set of n numbers using a class.
13. Create a class “Account” to represent a bank account. Write a program to deposit and withdraw amounts from the account.
14. Using class and objects, Write a java program to find the sum of two complex numbers (Hint: Use object as parameter to function).
15. Create a class Time with hh, mm, ss as data members. Write a java program to find the sum of two time intervals (Hint: Use object as parameter to function).
16. Write a program to count and display total number of objects created to a class (Hint: static members).
17. Write a java program to find the volume of cube, rectangular box, cylinder using function overloading.
18. Create a class student with methods to read and display the student details. Create a derived class result with methods to read marks of 5 subjects. Write a java program to display the total and grade of students, creating objects class result.

19. Create a class Employee with ID, Name Designation and Dept. Create a child class salary with Basic, HRA, DA and Allowance. Write a program to compute the net salary assuming that HRA is 1250, DA, Allowance are 110% and 35% of the Basic salary.
20. Write a program to demonstrate inheritance hierarchy by using class a base class shape and 'Two Dim' and 'Three Dim' as sub classes. Create classes “square” and 'triangle' derived from Two Dim and 'sphere and 'cube' derived from Three Dim. A reference variable of shape is used to determine area of various shapes.
21. Write a program to demonstrate the order in which constructors are invoked in multilevel inheritance.
22. Create an abstract class shape with two data members and an abstract method area. Create two child classes rectangle and triangle. Write a program to display the area of the shapes.
23. Create an interface calculator having methods to perform basic arithmetic operation. Write a program to implement the interface to perform operation on integer and float values.
24. Create a class factorial with a method that accept a number and return its factorial in a package P1. Using the factorial class, write a program to find the factorial of a number.
25. Write a multi thread java program for displaying odd numbers and even numbers up to a limit (Hint : Implement thread using Runnable interface).
26. Write a multi thread java program for displaying numbers ascending and descending order (Hint: create thread by inheriting Thread class).
27. Write a program to handle arithmetic exception.
28. Create a user defined exception “Min Bal Exp” to be invoked when the read number is less than a pre-set value.
29. Create a user defined exception “Odd Val Exp” to be invoked when the read number is an odd number.
30. Write a program to copy a file to another. Pass the file names as command line arguments.
31. Write a program to track keyboard events on an applet.
32. Write an applet to display a rectangle with specified coordinate and colour passed as parameter from the HTML file.
33. Create an AWT application to add, remove items in a list box.
34. Create an AWT application to select gender using radio buttons.
35. Design a window to accept the qualifications of a user using checkboxes.
36. Create an applet for a displaying smiling face.
37. Write a program to display ip address of the system.
38. Write a program to implement echo server (A server that echo the messages the client sends).
39. Create a database table employee (id, name, design, dept). Write a program to list the employees using JDBC.
40. Write a program to insert a new employee record to the above table.

SEMESTER IV

GDMA4B06P: STATISTICAL COMPUTING USING R

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To develop scientific and experimental skills to correlate theoretical principles of statistics with application based studies
- To familiarise the students with basics of statistics softwares R and SPSS

Module I **(16 Hours)**

Introduction to the statistical software R, Data objects in R, Creating vectors, Creating matrices, Manipulating data, Accessing elements of a vector or matrix, Lists, Addition, Multiplication, Subtraction, Transpose, Inverse of matrices. Read a file. Boolean operators

Module II **(16 Hours)**

Descriptive statistics using R, Measures of central tendency, Measures of dispersion, R-Graphics- Histogram, Box-plot, Stem and leaf plot, Scatter plot, Matplot, Plot options; Multiple plots in a single graphic window, Adjusting graphical parameters. Looping- For loop, repeat loop, while loop, if command, if else command

Module III **(16 Hours)**

Introduction to SPSS, Preparing data file, Inputting transforming and sorting data, Descriptive statistics using SPSS, Measures of central tendency, Measures of dispersion, Frequency tables, Graphical representation of data, Pearson correlation and rank correlation, Simple linear regression.

Module IV **(16 Hours)**

Statistical inference using SPSS, Checking normality of data, Independent sample t-test, Paired sample t-test, One-way ANOVA, Cross tabs odds ratio and Chi-square test, Non parametric tests, Mann-Whitney U test, Wilcoxon signed rank test, Kruskal-Wallis test.

Text

1. Michael J. Crawley (2005): "Statistics: An Introduction using R", Wiley, ISBN 0-470-02297-3
2. Field A., "Discovering Statistics Using SPSS", Fourth Edition, SAGE, 2013

References

1. Alain F. Zuur, Elena N. Ieno, and Erik Meesters (2009): "A Beginner's Guide to R"

Springer, ISBN: 978-0-387-93836-3.

2. Phil Spector (2008): “Data Manipulation with R”, Springer, New York, ISBN 978-0-387-74730-9.
3. Daniel j Denis (2018), “SPSS Data analysis for univariate bivariate and multivariate statistics” Wiley, ISBN: 9781119465775.

Examination Pattern

GDEC6B10P: STATISTICAL COMPUTING USING R

Marks: 75 [Internal: 15, External: 60 (Record: 20 & Practical Exam: 40)]
Pattern of External Practical Examination

Time 2 Hours Max. Marks: 40

Section A (Each question carries 2.5 Marks) (4x2.5 = 10 Marks)

I. Answer any 2 questions out of 3 from R programming
II. Answer any 2 questions out of 3 from SPSS

Section B (Each question carries 5 Marks) (2 x 5 = 10 Marks)

III. Answer any 1 question out of 2 from R programming
IV. Answer any 1 question out of 2 from SPSS

Section C (Each question carries 10 Marks) (2 x 10 = 20 Marks)

V. Answer any 1 question out of 2 from R programming
VI. Answer any 1 question out of 2 from SPSS

SEMESTER IV

GDMA4B07T: DIFFERENTIAL EQUATIONS

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- Evaluate first order differential equations including separable, homogeneous, exact, and linear.
- Show existence and uniqueness of solutions.
- Solve second order and higher order linear differential equations.
- Create and analyse mathematical models using higher order differential equations to solve application problems such as harmonic oscillator and circuits.
- Solve differential equations using variation of parameters
- Solve linear systems of ordinary differential equations

Course Outcomes

- Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.
- Student will be able to find the complete solution of a nonhomogeneous differential equation as a linear combination of the complementary function and a particular solution.
- Student will be introduced to the complete solution of a nonhomogeneous differential equation with constant coefficients by the method of undetermined coefficients.
- Student will be able to find the complete solution of a differential equation with constant coefficients by variation of parameters.
- Student will have a working knowledge of basic application problems described by second order linear differential equations with constant coefficients.

Module I (16 Hours)

1.1 Basic Concepts. Modeling
1.3 Separable ODEs. Modeling
1.4 Exact ODEs. Integrating Factors
1.5 Linear ODEs. Bernoulli Equation. Population Dynamics

Module II (16 Hours)

1.6 Orthogonal Trajectories
1.7 Existence and uniqueness of solutions (proofomitted)
2.1 Homogeneous Linear ODEs of Second Order
2.2 Homogeneous Linear ODEs with Constant Coefficients

2.3 Differential Operators.

Module III **(16 Hours)**

2.5 Euler-Cauchy Equation
2.6 Existence and Uniqueness Theory (proofomitted), Wronskian
2.7 Non-homogeneous ODEs
2.10 Solution by Variation of parameters
3.1 Homogeneous Linear ODEs

Module IV **(16 Hours)**

3.2 Homogeneous Linear ODEs with Constant Coefficients
3.3 Nonhomogeneous Linear ODEs
4.1 System of ODEs as models
4.2 Basic Theory of Systems of ODEs. Wronskian
4.6 Nonhomogeneous Linear Systems of ODEs

Text

1. Erwin Kreyzig, Advanced Engineering Mathematics, 9th Edition, John Wiley, 2006.

References

1. S.L. Ross: Differential Equations, 3rd ed., Wiley.
2. A.H. Siddiqi & P. Manchanda: A First Course in Differential Equation with Applications, Macmillan, 2006.
3. E.A. Coddington: An Introduction to Ordinary Differential Equation, PHI.

SEMESTER V

GDCS5B07T: DATA ANALYTICS USING PYTHON

Contact Hours per Week	**: 5 (3L + 2P)**
Number of Credits	**: 3**
Number of Contact Hours	**: 80 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To give brief knowledge about Data Analytics
- To learn various Scientific Libraries in Python
- Clear syntax facilitates ease of understanding and code indentation
- Active communities of libraries and modules developers

Course Outcomes

- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep data analytics using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
- Make better business decisions by using advanced techniques in data analytics.

Module I (12L)

Python fundamentals: fundamental programming concepts (variables, expressions etc.)- data types- controls flow-organizing code (functions, modules, packages- implementation of user defined modules and packages)- file handling- exception handling-object oriented programming concepts.

Module II (12L + 10P)

Introduction to data analytics: what is data analytics, steps involved in data analytics, tools used, applications Num Py: n-d array- understanding, creation, indexing and slicing, basic operations and manipulations. 2 D plotting with matplotlib.

Module III (12L + 10P)

Panda: input/output operations, 1D and 2D data structures (series and data frame), data alignment, aggregation, summarization, computataion and analysis, dealing with dates and times, visualization. 2D plotting with Pandas and Seaborn (line plots, bar plots, histograms, density plots, point plots, facet grids), categorical data

Module IV (12L + 12P)

Machine learning: introduction- supervised and unsupervised learning, batch and online learning, instant based versus model based learning, reinforcement learning.

Machine learning with scikit-Learn: data sets, data acquisition & cleaning (missing values, categorical data), data standardization, variance scaling and normalization, classification, model development using linear regression, classification, clustering, model visualization, prediction and decision making, model evaluation: over-fitting, under-fitting, model selection.

References

1. Bharat Motwani, Data Analytics using Python
2. Jeeva Jose, Taming Python by programming, Khanna Publishers. New Delhi
3. Doing Math with Python: Amit Saha
4. Let’s Python : Yashwant Kanetkar
5. Learning Python, 4th edition by Mark Lutz

SEMESTER V

GDCS5B08T: COMPUTER NETWORKS AND MOBILE COMPUTING

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To learn about transmissions in Computer Networks.
- To learn various Protocols used in Communication.
- To learn the basics of Mobile Computing.

Course Outline

- Understand the fundamental concepts of Computer Network.
- Familiarize with the basic taxonomy and terminology of Computer Network.
- Learn various Protocols used in Communication.
- Understand the basics of cryptography
- Learn the basics of Mobile computing.

Module I (16 Hours)

Introduction to Computer networks, Topology, categories of networks, Network Models, OSI and TCP/IP models, Physical layer- Switching, Circuit switching, Packet Switching, Message Switching. Data link layer- Error detection and correction, Types of errors, VRC, LRC, CRC, Error correction- Hamming code, Data link control- Line discipline, Flow control, Error control, Multiple Access, Random Access- ALOHA, pure ALOHA and slotted ALOHA, CSMA/CD, CMA/CA, Wired LANs- Ethernet- IEEE 802.3 standard, Wireless LANs- IEEE-802.11, Wireless Ad-hoc networks, Bluetooth.

Module II (16 Hours)

Network layer- Networking and Internetworking devices- Repeaters, Bridges, Routers, Gateways, Routing algorithms, Distance Vector Routing, Link State Routing, Logical addressing- IPv4 & IPv6 addresses. Transport layer- Process-to-process Delivery: UDP, TCP, Congestion control & Quality of Service.

Module III

Application Layer- Domain Name System- Remote Login- SMTP, FTP, HTTP. Cryptography and Network Security Attacks, Principles of Cryptography, Symmetric Key and Asymmetric key Ciphers, DES, AES, RSA, Digital Signature.

Module IV (16 Hours)

Mobile communication, Signals, Antennas, Signal propagation, Multiplexing, SDMA, TDMA, FDMA, CDMA, Cellular network- Channel Assignment, Frequency reuse, Handoff Strategies, introduction to 2G, 3G, 4G, building blocks of 5G, GSM, Mobile Services, GSM system Architecture, Radio Interface in GSM.

Text

1. Behurouz A. Forozan, Introduction to Data Communications & Networking, TMH.

2. Jochen Schiller, Mobile Communications, Second edition, Pearson.

References

1. Andrew S. Tanenbaum, Computer Networks, PHI
2. William Stallings, Data and Computer Communications, 7th Edition, Pearson Education
3. William Stallings, Cryptography and Network Security, Principles and Practices,
4. Prentice Hall of India.

SEMESTER V

GDCS5B09T: ARTIFICIAL INTELLIGENCE

Contact Hours per week	**: 3**
Number of Credits	**: 2**
Number of Contact Hours	**: 48 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To introduce the concepts of Artificial Intelligence
- To acquire knowledge on intelligent systems and agents, formalization of knowledge.

Course Outcomes

- Develop fundamental understanding of artificial intelligence (AI) and its foundations.
- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- Acquire the knowledge of real world Knowledge representation.

Module I **(12 Hours)**

Introduction- Artificial Intelligence- problem formulation, scope and applications, problem space and search- production system- characteristics- the predicate calculus, inference rules, structures and strategies for state space search, using state space to represent reasoning with the predicate calculus.

Module II **(12 Hours)**

Problem solving methods- Problem graphs, Matching, Indexing and Heuristic functions- Hill Climbing- Depth first and Breath first Search- Best First Search- A* Algorithm, AO* Algorithm, Constraint Satisfaction.

Module III **(12 Hours)**

Knowledge representation issues, representation and mappings, representing simple facts in logic, representing instances and IS A relationships, computable functions and predicates, knowledge representation using rules, logic programming, forward versus backward reasoning, symbolic reasoning under uncertainty- non-monotonic reasoning. First order logic, forward chaining, backward chaining.

Module IV **(12 Hours)**

Game playing- the mini-max search procedure, adding alpha-beta cut-offs, additional refinement, iterative deepening. Slot and filler structures: semantic nets, frames, conceptual dependency, scripts.

References

1. Elaine Rich, Kevin Knight and Shivshankar B. Nair, Artificial Intelligence, 3rd Edition, Tata -McGraw Hill, New Delhi, ISBN: 0070087709.
2. V.S. Janakiraman, K. Sarukesi and P. Gopalakrishnan, Foundations of Artificial Intelligence and Expert System, Macmillan India Limited, ISBN: 0333926250.
3. Stuart Russell and Peter Norvg, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, ISBN: 0136042597.'
4. G.F. Lugerand W.A. Stubblefield, Artificial Intelligence-Structures and Strategies for Complex Problem Solving, Addison-Wesley, 6th Edition, ISBN: 9780321545893.
5. P. H. Winston, Artificial Intelligence, Addison-Wesley, 3rd Edition, ISBN: 0201533774.
6. Nils J. Nilsson, Artificial Intelligence, A New Synthesis, 1st Edition, Morgan Kaufmann Publishers, Inc., ISBN: 1558604677.

SEMESTER V

GDMA5B08T: REAL ANALYSIS

Contact Hours per Week	**: 5**
Number of Credits	**: 4**
Number of Contact Hours	**: 80 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- Define the real numbers, least upper bounds, and the triangle inequality.
- Define functions between sets; equivalent sets; finite, countable and uncountable sets.
- Recognize convergent, divergent, bounded, Cauchy and monotone sequences.
- Calculate the limit superior, limit inferior, and the limit of a sequence.
- Recognize alternating, convergent, conditionally and absolutely convergent series.
- Determine if subsets of a metric space are open, closed, connected, bounded, totally bounded and/or compact.
- Determine if a function on a metric space is discontinuous, continuous, or uniformly continuous.

Course Outcomes

- Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
- Comprehend rigorous arguments developing the theory underpinning real analysis.
- Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.
- Construct rigorous mathematical proofs of basic results in real analysis.
- Appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

Module I **(12 Hours)**

Chapter 1: Preliminaries

1.3 Finite and Infinite Sets

Chapter 2: The Real Numbers

2.1 The Algebraic and Order Properties of $\mathbb{R}$

2.2 Absolute Value and the Real Line

Module II **(25 Hours)**

2.3 The Completeness Property of $\mathbb{R}$

2.4 Applications of the Supremum Property

2.5 Intervals

Chapter 3: Sequences and Series

3.1 Sequences and Their Limits

3.2 Limit Theorems

3.3 Monotone Sequences

Module III **(25 Hours)**

3.4 Subsequences and the Bolzano-Weierstrass Theorem

3.5 The Cauchy Criterion

3.6 Properly divergent sequences

3.7 Introduction to Infinite Series

Module IV **(18 Hours)**

Chapter 11: A Glimpse into topology

11.1 Open and Closed sets in $\mathbb{R}$

Appendix B: Finite and countable sets

Text

1. Introduction to Real Analysis (4/e): Robert G. Bartle, Donald R. Sherbert John Wiley & Sons (2011), ISBN: 978-0-471-43331-6.

References:

1. Charles G. Denlinger: Elements of Real Analysis Jones and Bartlett Publishers Sudbury, Massachusetts (2011) ISBN: 0-7637-7947-4 [Indian edition: ISBN-9380853157].
2. David Alexander Brannan: A First Course in Mathematical Analysis Cambridge University Press, US (2006) ISBN: 9780521684248.
3. John M. Howie: Real Analysis Springer Science & Business Media (2012) [Springer Undergraduate Mathematics Series] ISBN: 1447103416.
4. James S. Howland: Basic Real Analysis Jones and Bartlett Publishers Sudbury, Massachusetts (2010) ISBN: 0-7637-7318-2.
5. James Ward Brown, Ruel Vance Churchill: Complex variables and applications (8/e) McGraw-Hill Higher Education, (2009) ISBN: 0073051942.
6. Alan Jeffrey: Complex Analysis and Applications (2/e) Chapman and Hall/ CRC Taylor Francis Group (2006), ISBN: 978-1-58488-553-5.
7. Saminathan Ponnusamy, Herb Silverman: Complex Variables with Applications Birkhauser Boston (2006) ISBN: 0-8176-4457-4.

SEMESTER V

GDMA5B09T: ALGEBRA

Contact Hours per Week	**: 5**
Number of Credits	**: 4**
Number of Contact Hours	**: 80 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- Define and interpret the concepts of divisibility, congruence, greatest common divisor, prime, and prime-factorization.
- Present the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.
- Present concepts of and the relationships between operations satisfying various properties (e.g. commutative property).
- Present concepts and properties of various algebraic structures.
- Discuss the importance of algebraic properties relative to working within various number systems.
- Develop the ability to form and evaluate conjectures.

Course Outcomes

- Demonstrate knowledge and understanding of topics including, but not limited to divisibility, prime numbers, congruences, quadratic reciprocity, Diophantine equations.
- Learn methods and techniques used in number theory.
- Understand the importance of algebraic properties with regard to working within various number systems
- Generate groups given specific conditions.
- Investigate symmetry using group theory

Module I **(20 Hours)**

The division algorithm, The greatest common divisor, The Euclidean algorithm, The Diophantine equation ax+by= c, The fundamental theorem of arithmetic, The sieve of Eratosthenes (2.2, 2.3, 2.4, 2.5, 3.1, 3.2 from Text1).

Module II **(20 Hours)**

Basic properties of congruence, Linear congruences and the Chinese remainder theorem, Fermat’s little theorem and pseudo primes, Wilson’s theorem, The sum and number of divisors. (4.2, 4.4, 5.2, 5.3, 6.1 from Text 1).

Module III **(20 Hours)**

Binary operations; Isomorphic binary structures; Groups; Sub groups (Sections 2, 3, 4 & 5).

Module IV **(20 Hours)**

Cyclic groups; Groups and permutations; Orbits, cycles and Alternating groups (Sections 6, 8 & 9).

Text

1. David M. Burton: Elementary Number Theory, Seventh Edn., TMH.
2. John B. Fraleigh: A First Course in Abstract Algebra, 7th Ed., Pearson.

Reference

1. C.Y. Hsiung, Elementary Theory of Numbers, Allied Publishers.
2. N. Robbins, Beginning Number Theory, Second Edition. Narosa.
3. G.E. Andrews, Number Theory, HPC.
4. Joseph A. Gallian: Contemporary Abstract Algebra. Narosa Pub. House.
5. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nd ed., Cambridge University Press.
6. Artin: Algebra, PHI.

SEMESTER VI

GDCS6B10T: IMAGE PROCESSING

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- The objective of this course is to understand the basic principles and methods of digital image processing.
- To be able to formulate solutions to general image processing problems and have a comprehensive background in image filtering.
- The primary goal of this course is to lay a solid foundation for students to study advanced image analysis topics such as computer vision systems, biomedical image analysis, and multimedia processing & retrieval.

Course Outcomes

- The ability to apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.
- The ability to analyze and implement image processing algorithms.
- To Gain hands-on experience in using software tools for processing digital images.

Module I (14 Hours)

2D Signals, Separable and Periodic Sequences, 2D Systems, Classification of 2D Systems, Convolution and Correlation- Different Methods and Applications. Digital Image, Classification of digital images, Image Types and File Formats, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sampling and Quantisation, Basic Relationships between Pixels, Mathematical Tools used in digital image processing.

Module II (18 Hours)

Image Transforms: 2D Orthogonal and Unitary Transforms, 2D DFT, DCT, Walsh Transform, Hadamard Transform, Haar Transform, Slant Transform, KL Transform, SVD – Properties and Examples. Comparison of transforms.

Module III (16 Hours)

Image Enhancement: Point Operations- Types, Basic Intensity Transformation Functions, Histogram Processing. Fundamentals of Spatial Filtering, Smoothing and Sharpening Spatial domain Filters. Fundamentals of Frequency Domain Filtering, Smoothing and Sharpening Frequency domain Filters. Bit Plane Slicing, Homomorphic Filter, Image Arithmetic

Module IV **(16 Hours)**

Image Restoration and Compression: Image Degradation, Image Blur- Types, Image Restoration Techniques Classification, Image Restoration Model, Linear and Nonlinear Image Restoration Techniques. Blind Deconvolution- Classification. Image Denoising: Noises in Image- Classification. Image Compression: Fundamentals, Some Basic Compression Methods - Run Length Coding, Huffman Coding, Arithmetic Coding, Bit Plane Coding, Block Truncation Coding. JPEG Compression.

Text

1. Digital Image Processing, Gonzalez R.C. & Woods. R.E., 3/e, Pearson Education, 2008.

References

1. Digital Image Processing, Kenneth R Castleman, Pearson Education, 1995.
2. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education, 2009. Pvt Ltd, New Delhi
3. Fundamentals of Digital image Processing, Anil Jain K., Prentice Hall of India, 1989.
4. Image Processing, Sid Ahmed, McGraw Hill, New York, 1995.

SEMESTER VI

GDCS6B11T: CLOUD COMPUTING

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

Course Outcomes

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing

Module I

Introduction- evolution of cloud computing- system models for distributed and cloud computing- NIST cloud computing reference architecture- Infrastructure as a Service (IaaS)- resource virtualization- Platform as a Service (PaaS)- cloud platform & management- Software as a Service (SaaS)- available service providers, Public and Private Cloud.

Module II

Virtualization- basics of virtualization- types of virtualization- implementation levels of virtualization- virtualization structures- tools and mechanisms- virtualization of CPU, memory, I/O devices- desktop virtualization- server virtualization- Linux KVM, Xen, Qemu, LXC, OpenVZ.

Module III

Cloud infrastructure- FOSS cloud software environments- Eucalyptus, Open Nebula, Open Stack- Open Stack architecture- compute, object storage, image service, identity, dashboard, networking, block storage, metering, basic cloud orchestration and service definition.

Module IV

Programming model- parallel and distributed programming paradigms- Mapreduce, twister and iterative Mapreduce- mapping applications- programming support- Apache Hadoop-HDFS, Hadoop I/O, Hadoop configuration, Map Reduce on Hadoop. Security in the cloud-security overview- cloud security challenges.

References

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Distributed and Cloud Computing (From Parallel Processing to the Internet of Things), Elsevier Science, ISBN: 9780128002049.
2. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management, and Security, 1st Edition, CRC Press, ISBN: 1439806802.
3. Toby Velte, Robert Elsenpeter and Anthony Velte, Cloud Computing, A Practical Approach, TMH, ISBN: 9780071626958.
4. George Reese, Cloud Application Architectures, 1st Edition, Shroff /O'Reilly, ISBN: 8184047142.
5. Ravi Nair and Jim Smith, Virtual Machines: Versatile Platforms for Systems and Processes, 1st Edition, Elsevier Science / Morgan Kaufmann, ISBN: 9780080525402/ 1558609105.
6. Katarina Stanoevska- Slabeva, Thomas Wozniak, Santi Ristol, Grid and Cloud Computing- A Business Perspective on Technology and Applications, Springer, ISBN: 3642051928.
7. Open stack Operations Guide, http://docs.openstack.org/ops/.
8. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, ISBN: 9780596551360.

SEMESTER VI

GDCS6B12P: PROGRAMMING LAB III: MATLAB & PYTHON

Contact Hours per Week	**: 3**
Number of Credits	**: 3**
Number of Contact Hours	**: 48 Hours**
Course Evaluation	**: 100 Marks (Internal: 20 + External: 80)**
Time of External examination	**: 2.5 Hours**

Objectives

- To make the students learn MATLAB
- To make the students learn programming environments.
- To practice procedural programming concepts.
- To make the students equipped to solve mathematical or scientific problems using Python

Course Outcomes

- Knowledge in MATLAB
- Knowledge in Python

PART A

1. Obtain histogram equalization image.
2. Obtain complement image from the original image.
3. Program for image smoothing and sharpening.
4. Implement smoothing or averaging filter in spatial domain.
5. Program for opening and closing of the image.
6. To fill the region of interest for the image.
7. Program for edge detection algorithm.
8. Program of sharpen image using gradient mask.
9. Program for morphological operation: erosion and dilation.
10. Program for DCT/IDCT computation.
11. Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale) .
12. Implementation of Relationships between Pixels.
13. Implementation of Transformations of an Image.
14. Program to extract different Attributes of an Image.
15. Program for Power Law Transformation.
16. Program for morphological operations on binary images.
17. Write a MATLAB code that reads a gray scale image and generates the flipped image of original image.

PART B

1. Write a program of Apriori algorithm using Python.
2. Write a program of Naive Bayesian classification using Python.

3. Write a program of cluster analysis using simple k-means algorithm using Python.
4. List all the categorical (or nominal) attributes and the real-valued attributes separately.
5. Determining and classifying the credit good or bad in the dataset with Accuracy.
6. Demonstration of classification rule process on WEKA data-set using j48 algorithm.
7. Write a program add.py that takes 2 numbers as command line arguments and prints its sum.
8. Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . . . , 1/10
9. Write a program to demonstrate different number data types in python.
10. Write a program to demonstrate working with tuples in python
11. Write a program to demonstrate working with dictionaries in python
12. A) Create a list and perform the following methods 1) insert () 2) remove() 3) append() 4) len() 5) pop() 6) clear().
13. Write a program to create a menu with the following options
    1. TO PERFORM ADDITITON
    2. TO PERFORM SUBTRACTION
    3. TO PERFORM MULTIPICATION
    4. TO PERFORM DIVISION
14. Accepts users input and perform the operation accordingly. Use functions with arguments.
15. Write a python program to print date, time using date and time functions
16. Write a program to count frequency of characters in a given file.

SEMESTER VI

GDMA6B10T: NUMERICAL ANALYSIS

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs.
- The main objective of this course is to provide students with an introduction to the field of numerical analysis.
- Derive appropriate numerical methods to solve interpolation based problems.
- Derive appropriate numerical methods to solve probability based problems.
- Prove results for various numerical root finding methods.

Course Outcomes

- Understand the theoretical and practical aspects of the use of numerical analysis.
- Proficient in implementing numerical methods for a variety of multidisciplinary applications.
- Establish the limitations, advantages, and disadvantages of numerical analysis.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Understand of common numerical analysis and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

Module I **(14 Hours)**

Solutions of Equations in One Variable

Note: Students should be familiar with concepts and definitions such as ‘round off error’, ‘rate of convergence’ etc. discussed in sections 1.2 and 1.3

Introduction

2.1 The Bisection Method

2.2 Fixed-Point Iteration

2.3 Newton’s Method and Its Extensions-Newton’s Method (Newton- Raphson method), Convergence using Newton’s Method, The Secant Method, The Method of False Position [derivation of formula omitted in each case] **[Algorithms are omitted]**

Module II **(14 Hours)**

Interpolation and Polynomial Approximation

Introduction

3.1 Interpolation and the Lagrange Polynomial- motivation, Lagrange Interpolating Polynomials, error bound

3.3 Divided Differences-k^{th} divided difference, Newton's divided difference formula, Forward Differences, Newton Forward- Difference Formula, Backward Differences, Newton Backward–Difference Formula, Centered Differences, Stirling's formula. [derivation of formula omitted in each case] **[Algorithms are omitted]**

Module III **(18 Hours)**

Numerical Differentiation and Integration- Introduction

4.1 Numerical Differentiation- approximation of first derivative by forward difference formula, backward difference formula, Three-Point Formulas, Three-Point Endpoint Formula, Three-Point Midpoint Formula [Five-Point Formulas, Five-Point Endpoint Formula, Five-Point Midpoint Formula omitted] Second Derivative Midpoint Formula to approximate second derivative, Round-Off Error Instability

4.3 Elements of Numerical Integration- numerical quadrature, The Trapezoidal Rule, Simpson's Rule, Measuring Precision, Closed Newton-Cotes Formulas, Simpson's Three-Eighths rule, Open Newton-Cotes Formulas [derivation of formula omitted in each case] **[Algorithms are omitted]**

Module IV **(18 Hours)**

Initial-Value Problems for Ordinary Differential Equations- Introduction

5.1 The Elementary Theory of Initial-Value Problems

5.2 Euler's Method- derivation using Taylor formula, Error bounds for Euler Method

5.3 Higher- Order Taylor Methods- local truncation error, Taylor method of order n and order of local truncation error

5.4 Runge-Kutta Methods- only Mid Point Method, Modified Euler's Method and Runge-Kutta Method of Order Four are required [derivation of formula omitted in each case] **[Algorithms are omitted]**

Text Book

Numerical Analysis (10/e): Richard L. Burden, J Douglas Faires, Annette M. Burden, Brooks Cole Cengage Learning(2016) ISBN:978-1-305-25366-7

References

1. Kendall E. Atkinson, Weimin Han: Elementary Numerical Analysis (3/e)
2. John Wiley & Sons (2004) ISBN: 0-471-43337-3 [Indian Edition by Wiley India ISBN: 978-81-265-0802-0]
3. James F. Epperson: An Introduction to Numerical Methods and Analysis (2/e) John Wiley & Sons (2013), ISBN: 978-1-118-36759-9
4. Timothy Sauer: Numerical Analysis (2/e) Timothy Sauer: Numerical Analysis (2/e) Pearson (2012) ISBN: 0-321-78367-0, Pearson (2012), ISBN: 0-321-78367-0.
5. S.S. Sastri: Introductory Methods of Numerical Analysis (5/e) PHI Learning Pvt. Ltd.(2012) ISBN: 978-81-203-4592-8
6. Ward Cheney, David Kincaid: Numerical Mathematics and Computing (6/e) Thomson Brooks/Cole (2008) ISBN: 495-11475-8

SEMESTER VI

GDMA6B11T: LINEAR ALGEBRA

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**
Time of External examination	**: 2 Hours**

Objectives

- Solve systems of linear equations
- Analyze vectors in R^n geometrically and algebraically
- Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces
- Use matrix algebra and the related matrices to linear transformations
- Compute and use determinants
- Compute and use eigenvectors and eigenvalues
- Determine and use orthogonality
- Use technological tools such as computer algebra systems or graphing calculators for visualization and calculation of linear algebra concepts.

Course Outcomes

- Identify and construct linear transformations of a matrix.
- Characterize linear transformations as onto, one-to-one.
- Solve linear systems represented as linear transforms.
- Express linear transforms in other forms, such as matrix equations, and vector equations.
- Characterize a set of vectors and linear systems using the concept of linear independence.

Module I **(17 Hours)**

1.1 **Introduction to Systems of Linear Equations** Linear equation in n variables, linear system of m equations in n variables, solution, Linear Systems in Two and Three Unknowns, solution by geometric analysis, consistent and inconsistent systems, linear system with no, one, and infinite number of solutions, augmented matrix and elementary row operations.

1.2 **Gaussian elimination** Considerations in Solving Linear Systems, Echelon Forms, reduced row echelon form, Elimination Methods, Gauss–Jordan elimination, Gaussian elimination, Homogeneous Linear Systems, Free Variables, Free Variable Theorem for Homogeneous Systems, Gaussian Elimination and Back Substitution, Some Facts about Echelon Forms.

1.3 **Matrices and Matrix operations** Matrix Notation and Terminology, row vector, column vector, square matrix of order n, Operations on Matrices, Partitioned Matrices, Matrix Multiplication by Columns and by Rows, Matrix Products as Linear Combinations, linear combination of column vectors, Column Row Expansion, Matrix Form of a Linear System, Transpose of a Matrix, Trace of a Matrix.

1.4 **Inverses and algebraic properties of matrices** Properties of Matrix Addition and Scalar Multiplication, Properties of Matrix Multiplication, Zero Matrices and Properties, Identity Matrices, Inverse of a Matrix, Properties of Inverses, Solution of a Linear System by Matrix Inversion, Powers of a Matrix, Matrix Polynomials, Properties of the Transpose.

1.5 **Elementary matrices and a method for finding $\mathbf{A}^{-1}$**Equivalence, elementary matrix, Row Operations by Matrix Multiplication, invertibility of elementary matrices, invertibility and equivalent statements, A Method for Inverting Matrices, Inversion Algorithm, illustrations.

1.6 **More on linear systems and invertible matrices** Number of Solutions of a Linear System, Solving Linear Systems by Matrix Inversion, Linear Systems with a Common Coefficient Matrix, Properties of Invertible Matrices, equivalent statements for unique solution of $Ax = b$, determining consistency.

1.7 **Diagonal, Triangular and Symmetric matrices** Diagonal Matrices, Inverses and Powers of Diagonal Matrices, Triangular Matrices. Properties of Triangular Matrices, Symmetric Matrices, algebraic properties of symmetric matrices, Invertibility of Symmetric Matrices.

1.8 **Matrix transformations** Definition, Properties of Matrix Transformations, standard matrix, A Procedure for Finding Standard Matrices.

2.1 **Determinants by cofactor expansion** Minors, cofactors, cofactor expansion, Definition of a General Determinant, A Useful Technique for Evaluating 2 × 2 and 3×3 Determinants.

2.2 **Evaluating determinants by row reduction** Examples and problems to find determinant by row reduction (Theory omitted).

2.3 **Properties of Determinants; Cramer's Rule** Cramer's Rule (Only problems), Inverse of matrices using adjoint formula **(**Only problems).

Module II **(17 Hours)**

4.1 **Real vector space** Vector Space Axioms, examples, Some Properties of Vectors

4.2 **Subspaces** Definition, criteria for a subset to be a subspace, examples, Building Subspaces, linear combination, spanning, Solution Spaces of Homogeneous Systems as subspace, The Linear Transformation Viewpoint, kernel, different set of vectors spanning the subspace.

4.3 **Linear Independence** Linear Independence and Dependence, illustrations, A Geometric Interpretation of Linear Independence, Wronskian, linear independence using Wronskian

4.4 **Coordinates and basis** Coordinate Systems in Linear Algebra, Basis for a Vector Space, finite and infinite dimensional vector spaces, illustrations, Coordinates Relative to a Basis, Uniqueness of Basis Representation

4.5 **Dimension** Number of Vectors in a Basis, dimension, Some Fundamental Theorems, dimension of subspaces.

Module III **(20 Hours)**

4.6 Change of Basis Coordinate Maps, Change of Basis, Transition Matrices, Invertibility of Transition Matrices, An Efficient Method for Computing Transition Matrices for $\mathbb{R}^n$, Transition to the Standard Basis for $\mathbb{R}^n$

4.7 Row space, Column space and Null space Vector spaces associated with matrices, consistency of linear system, Bases for Row Spaces, Column Spaces, and Null Spaces, basis from row echelon form, Basis for the Column Space of a Matrix, row equivalent matrices and relationship between basis for column space, Bases Formed from Row and Column Vectors of a Matrix

4.8 Rank, Nullity, and the Fundamental Matrix Spaces Equality of dimensions of row and column spaces, Rank and Nullity, Dimension Theorem for Matrices, The Fundamental Spaces of a Matrix, rank of a matrix and its transpose, A Geometric Link Between the Fundamental Spaces, orthogonal complement, invertibility and equivalent statements, Applications of Rank, Over determined and Underdetermined Systems

4.9 Basic matrix transformations in $\mathbb{R}^2$ and $\mathbb{R}^3$Reflection Operators, Projection Operators, Rotation Operators, Rotations in $\mathbb{R}^3$, Dilations and Contractions, Expansions and Compressions, Shears, Orthogonal Projections onto Lines Through the Origin, Reflections About Lines Through the Origin

4.10 Properties of matrix transformations Compositions of Matrix Transformations, One-to One Matrix Transformations, Kernel and Range, fundamental relationship between invertibility of a matrix and its matrix transformation, Inverse of a One-to-One Matrix Operator

Module IV **(10 Hours)**

4.11 Geometry of matrix operators Transformations of Regions, Images of Lines Under Matrix Operators, Geometry of Invertible Matrix Operators, Elementary matrix and its matrix transformation, consequence

5.1 Eigen values and Eigen Vectors Definition, Computing Eigenvalues and Eigenvectors, characteristic equation, alternative ways of describing eigen values, Finding Eigenvectors and Bases for Eigen spaces, Eigenvalues and Invertibility, Eigenvalues of General Linear Transformations.

Text

1. Elementary Linear Algebra: Application Version(11/e): Howard Anton & Chris Rorres, Wiley (2014) ISBN 9781118434413

References

2. Linear Algebra Done Right: Sheldon Axler, Second Edition, Springer (2015), ISBN 978-3-319-11079-0.
3. Jim DeFranza, Daniel Gagliardi: Introduction to Linear Algebra with Applications Waveland Press, Inc (2015) ISBN: 1478627778.
4. Otto Bretscher: Linear Algebra with Applications (5/e) Pearson Education, Inc (2013) ISBN: 0321796977.

5. Ron Larson, Edwards, David C Falvo: Elementary Linear Algebra (6/e) Houghton Mifflin Harcourt Publishing Company (2009) ISBN: 0618783768.
6. David C. Lay, Steven R. Lay, Judi J. McDonald: Linear Algebra and its Application (5/e) Pearson Education, Inc (2016) ISBN: 032198238X.
7. Martin Anthony, Michele Harvey: Linear Algebra: Concepts and Methods Cambridge University Press (2012) ISBN: 9780521279482.
8. Jeffrey Holt: Linear Algebra with Applications W. H. Freeman and Company (2013) ISBN: 071678667.

SEMESTER VI

GDCS6B13D & GDMA6B12D: INDUSTRIAL VISIT AND PROJECT WORK

Contact Hours per Week	**: 2 L**
Number of Credits	**: 3**
Number of Contact Hours	**: 32 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**

Objectives

- To provide practical knowledge on software development process

Prerequisites

- Basic programming and system development knowledge

Course Outcomes

- Capability to acquire and apply principles of Software Engineering.
- Awareness about latest changes in technological world.
- Awareness about Global Industry.

Course Outline

The objective of the BSc Computer Science & Mathematics final project work is to develop a quality software solution by following the software engineering principles and practices. During the development of the project the students should involve in all the stages of the software development life cycle (SDLC). The main objective of this project course is to provide learners a platform to demonstrate their practical and theoretical skills gained during five semesters of study in B.Sc. Computer Science Programme & Mathematics.

During project development students are expected to define a project problem, do requirements analysis, systems design, software development, apply testing strategies and do documentation with an overall emphasis on the development of a robust, efficient and reliable software systems. The project development process has to be consistent and should follow standard.

For example data base tables designed in the system should match with the E-R Diagram. SRS documents to be created as per IEEE standards.

Students are encouraged to work on a project preferably on a live software project sponsored by industry or any research organization. Topics selected should be complex and large enough to justify as a B.Sc. Computer Science& Mathematics final semester project. The courses studied by the students during the B.Sc. Computer Science & Mathematics Programme provide them the comprehensive background knowledge on diverse subject areas in computer science such as computer programming, data structure, DBMS, Computer Organization, Software Engineering, Computer Networks, etc., which will be helping students in doing project work. Students can also undertake group project to learn how to work in groups. However, the maximum number of students in a group must be limited to 4.

For internal evaluation, the progress of the student shall be systematically assessed through two or three stages of evaluation at periodic intervals.
A bonafied project report shall be submitted in hard bound complete in all aspects.

Industrial Visit Guide Lines

- Minimum one day visit to National research Institutes, Laboratories, places of scientific Importance or Software Companies.

  OR
- One week Industrial Training/ internship at any software firms/ Research Labs
- The Industrial visit should be done in fifth or sixth semester.
- A 10 – 20 page Industrial visit/ Training report have to be submitted with certificate from industry/ institute, sufficient photos and analysis along with Project for evaluation in the sixth semester.

ELECTIVE COURSES

Elective 1

GDMA6E01T: ADVANCED GRAPH THEORY

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Hours (Internal- 15 + External- 60)**

Objectives

- To understand and apply the fundamental concepts in graph theory
- To apply graph theory based tools in solving practical problems
- To improve the proof writing skills.

Course Outcomes

- The students will be able to apply principles and concepts of graph theory in practical situations
- Able to understand the concept of colorings and theory.

Module I **(24 Hours)**

Vertex colouring, Vertex colouring algorithm, Critical graphs, cliques)
(Sections6.1 to 6.4)

Module II **(20 Hours)**

Cliques, Edge colouring, Map colouring, Directed graphs, In degree and out degree
(Section 6.5, 6.6, 7.1 & 7.2)

Module III **(20 Hours)**

Tournaments, Traffic flow, Flow and cuts, separating sets
(Section 7.3, 7.4, 8.1 & 8.3)

Text

1. John Clark Derek Allen Holton- A first look at graph theory, Allied Publishers

Reference

1. Douglas B West Peter Grossman- Introduction to Graph Theory
2. W.D. Wallis- A Biginner’s Guide to Discrete Mathematics, Springer
3. S. Arumugham, S. Ramachandran- Invitation to Graph Theory, Scitech. Peter Grossman.
4. J.K Sharma- Discrete Mathematics (2nd edition), (Macmillion)
5. S. A. Choudam- A First Course in Graph Theory, (Macmillian)

Elective 2

GDMA6E02T: FUZZY MATHEMATICS

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 64 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**

Objectives

- To introduce the theory of fuzzy sets.
- To discuss theoretical differences between fuzzy sets and classical sets.
- To discuss fuzzy logic inference
- To introduce fuzzy arithmetic concepts.
- To discuss fuzzy inference applications in the area of control

Course Outcomes

- interpret fuzzy set theory and uncertainty concepts
- apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem apply fuzzy control by examining simple control problem examples

Module I **(15 Hours)**

Introduction, Crisp Sets: An Overview, Fuzzy Sets: Basic Types, Fuzzy Sets: Basic concepts. Additional properties of α cuts, Representation of fuzzy sets, Extension principle of fuzzy sets (Chapter 1 – 1.1, 1.2, 1.3, 1.4 and Chapter 2−2.1, 2.2, 2.3).

Module II **(20 Hours)**

Operations on Fuzzy Sets: Types of Operations, Fuzzy complements, Fuzzy intersections: t-norms, Fuzzy Unions: t- conorms, Combinations of operations. (Theorems 3.7, 3.8, 3.11, 3.13, 3.16 and 3.18 statements only) (Chapter 3- 3.1, 3.2, 3.3, 3.4, 3.5).

Module III **(14 Hours)**

Fuzzy Arithmetic: Fuzzy numbers, Arithmetic operations on Intervals, Arithmetic operations on Fuzzy numbers (Exclude the proof of Theorem 4.2), Lattice of fuzzy numbers, Fuzzy equations Chapter 4- 4.1, 4.3, 4.4, 4.5, 4.6).

Module IV **(15 Hours)**

Fuzzy Logic: Classical Logic: An Overview, Multivalued Logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy propositions (Chapter 8- 8.1, 8.2, 8.3, 8.4, 8.5 and 8.6 only).

Text

1. George J. Klir and Bo Yuan- Fuzzy Sets and Fuzzy Logic Theory and Applications', Prentice Hall of India Private Limited New Delhi, 2000.

Reference

1. Klir, G. J and T. Folger, Fuzzy Sets, Uncertainty and Information, Prentice Hall of India Private Limited New Delhi, (1988).
2. H.J Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, 1996.
3. Dubois, D and H. Prade, Fuzzy Sets and System: Theory and Applications, Academic Press, New York, 1988.
4. Abraham Kandel, Fuzzy Mathematical Techniques with Applications, Addison-Wesley Publishing Company 1986.

Elective 3

GDMA6E03T: METRIC SPACES

Contact Hours per Week **: 4**
Number of Credits **: 3**
Number of Contact Hours **: 64 Hours**
Course Evaluation **: 75 Marks (Internal: 15 + External: 60)**

Objectives

- To provide a strong foundation in basic concepts of Real Analysis which will enrich them to have a good knowledge in Pure Mathematics.
- To impart the knowledge of Metric space, Continuity, Connectedness and Compactness.

Course Outcomes

- Demonstrate an understanding of metric spaces by proving unseen results using the methods of the course.
- Correctly state the main definitions and theorems in the course.
- Produce examples and counterexamples illustrating the mathematical concepts presented in the course.
- Explain their reasoning about rigorous Analysis clearly and precisely, using appropriate technical language.

Module I **(16 Hours)**

Metric spaces: Definition and examples, Sequences in metric spaces, Cauchy sequences, Complete metric space (Relevant parts from Sections 1.1 to 1.5).

Module II **(16 Hours)**

Open and closed ball, Neighbourhood, Open set, Interior of a set, Limit point of a set, Derived set, Closed set, Closure of a set, Diameter of a set, Cantor’s theorem, Subspaces, Dense set.

Module III **(16 Hours)**

Continuous mappings, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mapping, Banach fixed point theorem.

Module III **(16 Hours)**

Connectedness, Connected subsets of $\mathbb{R}$, Connectedness and continuous mappings, Compactness, Compactness and boundedness, Continuous functions on compact spaces (Relevant parts from Sections 4.1, 5.1, 5.2 & 5.3).

Text

1. Shirali, Satish & Vasudeva, H. L. (2009). *Metric Spaces*, Springer, First Indian Print.

References

1. Kumaresan, S. (2014). *Topology of Metric Spaces* (2nd ed.). Narosa Publishing House. New Delhi.
2. Simmons, George F. (2004). Introduction to Topology and Modern Analysis. McGraw-Hill Education. New Delhi.

OPEN COURSES

SEMESTER V

OPEN COURSE 1

(For students not having Mathematics as Core Course)

APPLIED CALCULUS

Contact Hours per Week	**: 4**
Number of Credits	**: 3**
Number of Contact Hours	**: 48 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**

Objectives

- Compute limits, derivatives, and integrals.
- Analyze functions using limits, derivatives, and integrals.
- Recognize the appropriate tools of calculus to solve applied problems.

Course Outcomes

- Students completing this course will be able to find a limit of a function graphically.
- Students completing this course will be able to compute the derivative of an algebraic function.
- Students completing this course will be able to find a (linear) Marginal Cost function and interpret it.
- Students completing this course will be able to find the area between two curves.

Module I (16 Hours)

Chapter1: Functions, Graphs, and Limits

1.1 Functions

1.2 The Graph of a Function

1.3 Linear Functions

1.4 Functional Models

1.5 Limits

1.6 One sided limits and continuity

Chapter2: Differentiation: Basic Concepts

2.1 The Derivative

2.2 Techniques of Differentiation

2.3 Product and quotient rules: Higher order derivatives [proof of product and quotient rules omitted]

2.4 The Chain rule [proof of general power rule omitted]

Module II (18 Hours)

2.5 Marginal Analysis and Applications using increments

2.6 Implicit Differentiation and Related Rates

Chapter 3: Additional Applications of Derivative

3.1 Increasing and Decreasing Functions; Relative Extrema,
3.2 Concavity and Points of Inflection
3.4 Optimization; Elasticity of Demand
3.5 Additional Applied Optimization
Chapter 4: Exponential and Logarithmic Functions
4.1 Exponential functions; continuous compounding
4.2 Logarithmic functions

Module II **(14 Hours)**

Chapter5: Integration
5.1 Anti differentiation: The Indefinite Integral
5.2 Integration by Substitution
5.3 The Definite Integral and the Fundamental Theorem of Calculus [only statement of FTC required; Justification given at the end of the section omitted]
5.5 Additional Applications to Business and Economics
5.6 Additional Applications to the Life and Social Sciences [The derivation of volume formula omitted; only the formula and its applications required]

Text

1. Calculus: For Business, Economics, and the Social and Life Sciences BRIEF (10/e): Laurence D. Hoffmann, Gerald L. Bradley McGraw-Hill (2010), ISBN: 978–0–07–353231–8

References

1. Soo T Tan: Applied Calculus for the Managerial, Life, and social sciences(8/e) Cengage Learning(2011) ISBN: 978-0-495-55969-6
2. Ron Larson : Brief Calculus An Applied Approach(8/e)Houghton Mifflin Company(2009)ISBN: 978-0-618-95847-4
3. Stefan Waner, Steven R. Costenoble: Finite Mathematics and Applied Calculus (5/e) Brooks/ Cole Cengage Learning (2011) ISBN: 978-1-4390-4925-9
4. Frank C. Wilson, Scott Adamson: Applied Calculus Houghton Mifflin Harcourt Publishing Company (2009)
5. Geoffrey C. Berresford, Andrew M. Rockett: Applied Calculus(7/e) Cengage Learning (2016)ISBN: 978-1-305-08531-2

SEMESTER V

OPEN COURSE 2

(For students not having Mathematics as Core Course)

DISCRETE MATHEMATICS FOR BASIC AND APPLIEDSCIENCES

Contact Hours per Week	**: 3**
Number of Credits	**: 3**
Number of Contact Hours	**: 48 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**

Objectives

- Introduce concepts of mathematical logic for analyzing propositions and proving theorems.
- Use sets for solving applied problems, and use the properties of set operations algebraically.
- Work with relations and investigate their properties.
- Investigate functions as relations and their properties.
- Introduce basic concepts of graphs, digraphs and trees.

Course Outcomes

- Analyze logical propositions via truth tables.
- Prove mathematical theorems using mathematical induction.
- Understand sets and perform operations and algebra on sets.
- Determine properties of relations, identify equivalence and partial order relations, sketch relations.
- Identify functions and determine their properties.
- Define graphs, digraphs and trees, and identify their main properties.
- Evaluate combinations and permutations on sets.

Module I **(14 Hours)**

Chapter- 1 Logic

1.1 Propositions and Truth Values

1.2 Logical Connectives and Truth Tables- Disjunction, Conditional Propositions, Bi conditional Propositions

1.3 Tautologies and Contradictions

1.4 Logical Equivalence and Logical Implication- More about conditionals

1.5 The Algebra of Propositions- The Duality Principle, Substitution Rule

1.6 Arguments

1.7 Formal Proof of the Validity of Arguments

1.8 Predicate Logic- The Universal Quantifier, The Existential Quantifier, Two-Place Predicates, Negation of Quantified Propositional Functions

1.9 Arguments in Predicate Logic- Universal Specification (US), Universal Generalization

(UG), Existential Specification (ES), Existential Generalization (EG)

Module II **(16 Hours)**

Chapter 8- Algebraic Structures

8.1 Binary Operations and Their Properties
8.2 Algebraic Structures- Semigroups
8.3 More about Groups
8.4 Some Families of Groups- Cyclic Groups, Dihedral Groups, Groups of Permutations
8.5 Substructures
8.6 Morphisms

Chapter 10- Boolean Algebra

10.1 Introduction
10.2 Properties of Boolean Algebras
10.3 Boolean Functions
10.4 Switching Circuits
10.5 Logic Networks
10.6 Minimization of Boolean Expressions

Module III **(18 Hours)**

Chapter 11- Graph Theory

11.1 Definitions and Examples
11.2 Paths and Cycles
11.3 Isomorphism of Graphs
11.4 Trees
11.5 Planar Graphs *[proof of Euler formula omitted]*
11.6 Directed Graphs

Chapter 12- Applications of Graph Theory

12.2 Rooted Trees
12.3 Sorting
12.4 Searching Strategies

Text

1. Discrete Mathematics; Proofs, Structures and Applications (3/e): Rowan Garnier & John Taylor CRC Press, Taylor & Francis Group (2009), ISBN: 978-1-4398-1280-8 (hardback)/ 978-1-4398-1281-5 (eBook- PDF).

References

1. Edward R. Scheinerman: Mathematics A Discrete Introduction (3/e) Brooks/Cole, Cengage Learning (2013) ISBN: 978-0-8400-4942-1
2. Gary Haggard, John Schlipf, Sue Whitesides: Discrete Mathematics for Computer Science Thomson Brooks/ Cole (2006) ISBN: 0-534-49601-x
3. D.P. Acharjya, Sreekumar: Fundamental Approach to Discrete Mathematics New Age International Publishers (2005) ISBN: 978-81-224-2304-4

4. Gary Chartrand, Ping Zhang: Discrete Mathematics Waveland Press, Inc. (2011) ISBN: 978-1-57766-730-8
5. Tom Jenkyns, Ben Stephenson: Fundamentals of Discrete Math for Computer Science A Problem-Solving Primer Springer-Verlag London (2013) ISBN: 978-1-4471-4068-9
6. Faron Moller, Georg Struth: Modelling Computing Systems Mathematics for Computer Science Springer-Verlag London (2013) ISBN 978-1-84800-321-7

SEMESTER V
OPEN COURSE 3
(For students not having Mathematics as Core Course)

LINEAR MATHEMATICAL MODELS

Contact Hours per Week	**: 3**
Number of Credits	**: 3**
Number of Contact Hours	**: 48**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**

Objectives

- Analyze and solve linear programming models of real-life situations.
- The graphical solution of LPP with only two variables, and illustrate the concept

Course Outcomes

- the students will be able to Understand the idea of slope of the lines, understand to find solution of Linear Systems by the Echelon Method and Gauss Jordan method
- Gets an idea of matrices, understand how to add, subtract and multiplication of matrices and understand how find the inverse of a matrix
- Understand the methods of solving linear programming problems geometrically and understands the drawbacks of geometric methods and to solve LP problems more effectively using Simplex method
- Understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization

Module I **(18 Hours)**

Chapter- 1 Linear Functions
1.1: Slopes and Equations of Lines
1.2: Linear Functions and Applications
1.3: The Least Squares Line
Chapter- 2 Systems of Linear Equations and Matrices
2.1: Solution of Linear Systems by the Echelon Method
2.2: Solution of Linear Systems by the Gauss-Jordan Method
2.3: Addition and Subtraction of Matrices
2.4: Multiplication of Matrices
2.5: Matrix Inverses
2.6: Input-Output Models

Module II **(12 Hours)**

Chapter-3 Linear Programming: The Graphical Method
3.1: Graphing Linear Inequalities

3.2: Solving Linear Programming Problems Graphically
3.3: Applications of Linear Programming

Module III **(18 Hours)**
Chapter- 4 Linear Programming: The Simplex Method
4.1: Slack Variables and the Pivot
4.2: Maximization Problems
4.3: Minimization Problems; Duality
4.4: Nonstandard Problems

Text

1. Finite Mathematics and Calculus with Applications (9/e) Margaret L. Lial, Raymond N. Greenwell & Nathan P. Ritchey Pearson Education, Inc. (2012). ISBN: 0-321-74908-1

References

1. Soo T Tan: Finite Mathematics For the Managerial, Life, and social sciences (11/e) Cengage Learning (2015) ISBN: 1-285-46465-6.
2. Ronald J. Harshbarger, James J. Reynolds: Mathematical Applications for the Management, Life, and Social Sciences (9/e) Brooks/Cole Cengage Learning (2009) ISBN: 978-0-547-14509-9.
3. Stefan Waner, Steven R. Costenoble: Finite Mathematics and Applied Calculus (5/e) Brooks/ Cole Cengage Learning (2011) ISBN: 978-1-4390-4925-9.
4. Seymour Lipschutz, John J. Schiller, R. Alu Srinivasan: Beginning Finite Mathematics Schaum's Outline Series, McGraw-Hill (2005).
5. Howard L. Rolf: Finite Mathematics Enhanced Edition (7/e) Brooks/Cole, Cengage Learning (2011) ISBN: 978-0-538-49732-9.
6. Michael Sullivan: Finite Mathematics An Applied Approach (11/e) John Wiley & Sons, Inc. (2011) ISBN: 978-0470-45827-3.

SEMESTER V

OPEN COURSE 4

(For students not having Mathematics as Core Course)

MATHEMATICS FOR DECISION MAKING

Contact Hours per Week	**: 3**
Number of Credits	**: 3**
Number of Contact Hours	**: 48 Hours**
Course Evaluation	**: 75 Marks (Internal: 15 + External: 60)**

Objectives

- To study about data collection and data classification.
- To study about measures of central tendency
- To introduce basics of probability
- To introduce probability distribution

Course Outcomes

- The student could understand the classifications of data. Student is also introduced to various data collection techniques
- Student will learn to visualize various types of data with the use of frequency charts and appropriate graphs
- Student understands concepts like measures of central tendency, measures of variation and measures of position
- Student gets a clear understanding of basic probability concepts. Student learns conditional probability, addition rule and other basic theories in probability
- Student will learn various probability distributions of discrete and continuous variables
- Student learns about the normal distribution, which is an important continuous probability distribution in inferential statistics
- Student understands the standard normal distribution and learns the conversion of normal variable to standard normal variable

Module I **(16 Hours)**

Chapter1 Introduction to Statistics

1.1 An Overview of Statistics

1.2 Data Classification

1.3 Data Collection and Experimental Design

Chapter2 Descriptive Statistics

2.1 Frequency Distributions and their Graphs

2.2 More Graphs and Displays

2.3 Measures of Central Tendency

2.4 Measures of Variation

2.5 Measures of Position

Module II **(16 Hours)**

Chapter3 Probability

3.1 Basic Concepts of Probability and Counting

3.2 Conditional Probability and the Multiplication Rule

3.3 The Addition Rule

3.4 Additional topics in probability and counting

Module III **(16 Hours)**

Chapter4 Discrete Probability Distribution

4.1 Probability Distributions

4.2 Binomial Distributions

4.3 More Discrete Probability Distributions

Text

1. Elementary Statistics: Picturing the World (6/e) Ron Larson &
2. Betsy Farber Pearson Education, Inc. (2015) ISBN: 978-0-321-91121-6

References

1. Mario F. Triola: Elementary Statistics (13/e): Pearson Education, Inc. (2018) ISBN: 9780134462455.
2. Neil A. Weiss: Elementary Statistics (8/e) Pearson Education, Inc. (2012) ISBN: 978-0-321-69123-1.
3. Nancy Pfenning: Elementary Statistics: Looking at Big Picture Brooks/ Cole Cengage Learning (2011) ISBN: 978-0-495-01652-6.
4. Frederick J. Gravetter, Larry B. Wallnau: Statistics for the Behavioral Sciences (10/e) Cengage Learning(2017) ISBN: 978-1-305-50491-2.
5. Seymour Lipschutz, John J. Schiller, R. Alu Srinivasan: Beginning Finite Mathematics Schaum's Outline Series, Mc Graw-Hill (2005).
6. Michael Sullivan: Finite Mathematics An Applied Approach (11/e) John Wiley & Sons, Inc(2011) ISBN: 978-0470-45827-3.