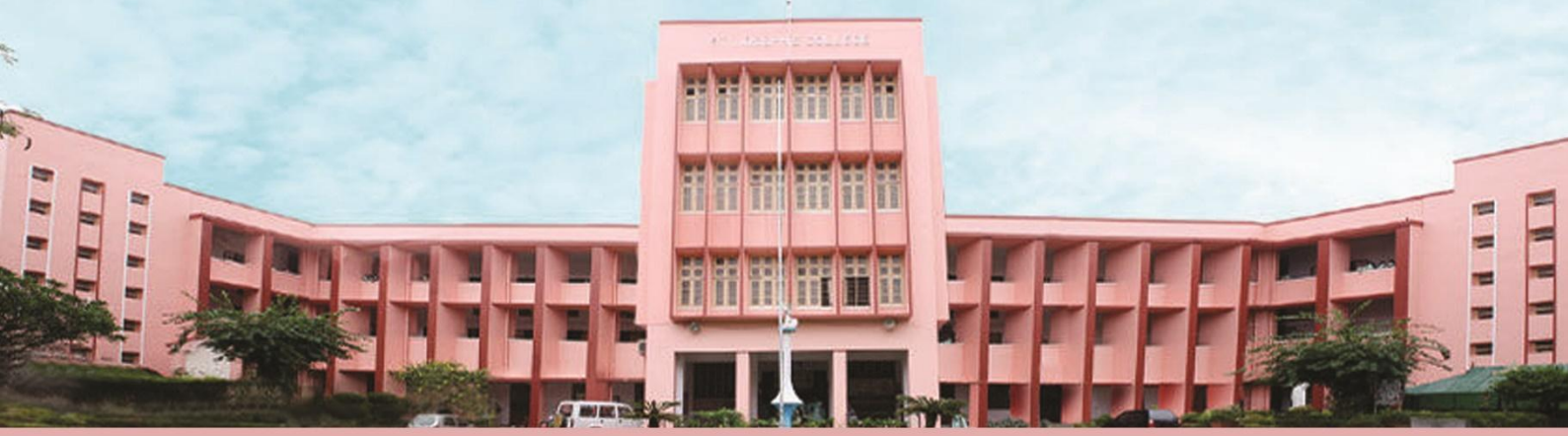

ST. JOSEPH'S COLLEGE (AUTONOMOUS)

IRINJALAKUDA

CURRICULA AND SYLLABI FOR

B. Voc. Mathematics & Artificial Intelligence

Under Choice Based Credit Semester System
For Vocational Under Graduate Curriculum

2021 Admissions

St. Joseph's College (Autonomous), Irinjalakuda

Department of Mathematics

Board of Studies in Mathematics

Chairman

Ms. Sherin Jose T,
Assistant Professor & Head, Department of Mathematics,
St. Joseph's College (Autonomous), Irinjalakuda,

University Nominee

Dr. Sunil Jacob John,
Professor, Department of Mathematics, NIT, Calicut.

Panel of Experts outside the College

Dr. Sajith G,
Head, Department of Mathematics,S S College, Areacode, Ugrapuram, Malappuram

Dr. Subrahamanian K.S Moosath,
Professor and Head, Department of Mathematics, IIST, Thiruvananthapuram

Dr. P.B. Vinodkumar,
Professor and Head, Department of Mathematics, RSET, Kakkanad

Dr. Sr. Mariyamma K. D.
Assistant Professor, Department of Statistics, Christ College (Autonomous), Irinjalakuda

Alumna

Dr. Savitha K.S ,
Assistant Professor, Department of Mathematics, St.Paul's College, Kalamasserry .

Industry Person

Mr. Arun Anirudhan V
Engineer 'D' Sree Chitra Tirunal Institute for Medical Sciences and Technology

SUBJECT EXPERTS WHO HAVE CONTRIBUTED TOWARDS THE CURRICULUM AND SYLLABUS IN ARTIFICIAL INTELLIGENCE

Dr. B. Kannan. Professor, Department of Computer applications, CUSAT, Kochi

Dr. Vinod P. Professor, Department of Computer Applications, CUSAT, Kochi

Mr. Mithun Haridas T. P. Assistant Professor, Department of Electronics, CUSAT, Kochi

Ms. Krishnachalitha K C, Assistant Professor, Department of IT, Jaihind College (Autonomous) Mumbai

Mr. Sushil Sony, Product Manager, LiveWire Career Institute, Jaipur(Industry)

FACULTY MEMBERS WHO HAVE CONTRIBUTED TOWARDS THE CURRICULUM AND SYLLABUS

Ms. Sinda Joy, Assistant Professor, Department of Mathematics

Ms. Dhanya V.S, Assistant Professor, Department of Mathematics

Dr. Sr. Deeni C J, Assistant Professor, Department of Mathematics

Dr. Fijy Jose P, Assistant Professor, Department of Mathematics

Ms. Alphy Joseph, Assistant Professor, Department of Mathematics

Ms. Sonadas P. Guest Faculty, Department of Mathematics

Ms. Anju Davis P. Guest Faculty, Department of Mathematics

Ms. Baby A. K. Assistant Professor in Statistics, Department of Mathematics

Ms. Radhika V. M., Guest Faculty in Artificial Intelligence, Department of Mathematics

FOREWORD

Higher Education scenario in Kerala has been going through turbulent transformations in recent times with the grant of autonomy to colleges by the State Government. There is no doubt about the qualitative worth of the institutions handpicked for autonomy. However, there are apprehensions about the absorption and implementation of the package of autonomy. St. Joseph's College was given autonomy in the year 2016, and has since then been endeavoring to reinvent itself.

Academic autonomy has given us the freedom to create our own curriculum and syllabus keeping in mind the challenges and changing needs of the society, the nation, the industry and the world. Hence, a structured feedback on the requirements of the new millennium was sought from all the relevant stakeholders of the institution- students, faculty, alumnae, parents, industry experts, employers etc.

The suggestions of the stakeholders were incorporated into the curricula and syllabi, and presented in the respective Boards of Studies for discussion. The suggestions pointed out were duly considered and the restructured syllabi are then presented to and ratified by, the Academic Council.

The role of the IQAC of the college in the above exercise is laudatory. The Cell spearheads all the quality enhancement endeavors, including that of curriculum and syllabus redesigning. By organizing workshops, seminars and hands on training sessions, the cell has facilitated a smooth conduct of the restructuring process. At the end of the year, an evaluation of the syllabi followed is also undertaken, with suggestions noted down for future changes.

As an institution that wishes seriously to provide enhanced quality education to young women students in order to empower them to be fit for the changing world, St. Joseph's College is bravely facing the challenges even as it is happily handling the possibilities, that autonomy has brought to it. Academic enriching programs, skill – based micro credentials, ICT up gradations, promotional activities for a culture of research, etc. are a few of the multifarious responsibilities invested with the college in its restructuring of curriculum and redesigning of syllabus.

I specially thank the IQAC, the Heads of various departments, the faculty and staff, directly in charge of the syllabus for their sincere and dedicated efforts.

Principal

ACKNOWLEDGEMENT

I acknowledge with gratitude all the guidance and help given by our Principal, Dr. Sr. Asha Therese during the course of restructuring of the syllabi. I also remember and acknowledge with gratitude all the members of the Board of Studies (Mathematics) and Experts in AI for their constructive suggestions and contributions in restructuring the syllabi of all the courses in B. Voc. Mathematics and Artificial Intelligence. I also express my sincere thanks for guidance of Dr. Mangalambal N. R. Former Head of the Department of Mathematics, St. Joseph's College (Autonomous) Irinjalakuda for giving guidance to structure the new curriculum. I am also grateful to all the members of the Curriculum Committee of the college for their guidance during Curriculum construction process. Above all, I bow my head before God Almighty for all the guidance he has continuously given to us in all our endeavors.

Ms. SHERIN JOSE T
Assistant Professor & Head
Department of Mathematics

AIMS AND OBJECTIVES

The B. Voc. programme is designed with the following objectives:

a) To provide judicious mix of skills relating to a profession and appropriate content of General Education.

b) To ensure that the students have adequate knowledge and skills, so that they are work ready at each exit point of the programme.

c) To provide flexibility to the students by means of pre-defined entry and multiple exit points.

d) To integrate NSQF within the undergraduate level of higher education in order to enhance employability of the graduates and meet industry requirements. Such graduates apart from meeting the needs of local and national industry are also expected to be equipped to become part of the global workforce.

e) To provide vertical mobility to students coming out of 10+2 with vocational subjects

PROGRAMME OUTCOMES

At the end of a Vocational UG programme, a student would have :

PO1. acquired adequate knowledge of the subject

PO2. crafted a foundation for higher learning

PO3. been initiated into the basics of research

PO4. imbibed sound moral and ethical values

PO5. become conscious of environmental and societal responsibilities

PO6. attained skills for communication and career

PO7. learned to tolerate diverse ideas and different points of view

PO8. become empowered to face the challenges of the changing universe

PROGRAMME SPECIFIC OUTCOME

PSO1. Attain a good foundation in Mathematics and Artificial Intelligence in the undergraduate level enabling them to take up higher studies in both Mathematics and Artificial Intelligence

PSO2. Introduce to powerful tools for tackling a wide range of topics in Mathematics and Artificial Intelligence.

PSO3. Familiarize with additional relevant mathematical & AI techniques subjects to complement the core.

PSO4. Understand a range of topics in almost all areas of Mathematics and Artificial Intelligence

PSO5. Attain Vocational and profession skill in AI system design and IOT programming along with mathematical and statistical problem Solving Skill

CONTENT

PROGRAMME STRUCTURE

The B. Voc Programme is designed to bridge the potential skill gap identified between academics and industry. The curriculum in each of the years of the programme contains General Education Components, Skill Development Components and Ability Enhancement Courses/audit courses.

A. General Education Components (GEC):

General Education Components are included in the programme to have enhance communication skill and general awareness, which are in the pattern of LRP Programme of University of Calicut. Group 6 papers included in the LRP pattern has to be followed for A11 to A14 papers

B. Skill Development Components (SDC):

AI skill with strong mathematical background is the most demanded for industry, which is the skill gap identified for a student with skill in mathematics and statistics. In this programme, Artificial Intelligence, Mathematics and Statistics papers along with electives are included in skill development component to attain a strong foundation in AI

C. Ability Enhancement Courses/Audit Courses (AEC /AC):

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. The students can also attain these credits through online courses like SWAYAM, MOOC etc (optional).

SCHEME

Semester I									
C.No	Course Code	Course Name	Credit	Marks			Hours/week		
				Int	Ext	total	Th	Prac	Total
1.1	A01	English	3	15	60	75	3		3
1.2	A02	English	3	15	60	75	3		3
1.3	A07(3)	Malayalam /Hindi	4	20	80	100	4		4
1.4	SJSDC1ST01	Descriptive Statistics and Introduction to R	4	20	80	100	4		4
1.5	SJSDC1MT02	Calculus of Single variable 1	4	20	80	100	4		4
1.6	SJSDC1AI03	Introduction to Artificial Intelligence	4	20	80	100	4		4
1.7	SJSDC1AI04	Python Programming	4	20	80	100	4		4
1.8	SJSDC1AI05(P)	Python Programming (Lab)	4	20	80	100		4	4
1.9		Environmental Studies	4*						
		Semester I total	**30**	**150**	**600**	**750**	**26**	**4**	**30**
Semester II									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
2.1	A03	English	4	20	80	100	4		4
2.2	A04	English	4	20	80	100	4		4
2.3	A08(3)	Malayalam /Hindi	4	20	80	100	4		4
2.4	SJSDC2MT06	Calculus of Single Variable 2	4	20	80	100	4		4
2.5	SJSDC2AI07	Data Structures and Algorithms	3	15	60	75	3		3
2.6	SJSDC2ST08(P)	Descriptive statistics using R (Lab)	2	15	60	75		2	2
2.7	SJSDC2AI09(P)	Data Structures and Algorithms (Lab)	4	20	80	100		4	4
2.8	SJSDC2AI10	Mini project	5	20	80	100		5	5
2.9		Disaster management	4*						
		Semester II total	**30**	**150**	**600**	**750**	**18**	**11**	**30**

Semester III									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
3.1	Group- 6 A11	Basic Mathematics And General Awareness	4	20	80	100	4		4
3.2	Group- 6 A12	Professional Business Skill	4	20	80	100	4		4
3.3	SJSDC3ST11	Probability and Statistical Methods	4	20	80	100	4		4
3.4	SJSDC3MT12	Calculus of Multivariable	4	20	80	100	4		4
3.5	SJSDC3MT13	Differential Equations	4	20	80	100	4		4
3.6	SJSDC3AI14	Introduction to Machine Learning	3	15	60	75	3		3
3.7	SJSDC3AI15(P)	Machine Learning (Lab)	3	15	60	75		3	3
3.8	SJSDC3AI16(P)	Artificial Intelligence (Lab)	4	20	80	100		4	4
3.9		Human Rights/ Intellectual Property right/ Consumer Protection	4*						
		Semester III Total	**30**	**150**	**600**	**750**	**25**	**7**	**30**
Semester IV									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
4.1	Group- 6 A13	Entrepreneurship development	4	20	80	100	4		4
4.2	Group- 6 A14	Public health sanitation and safety	4	20	80	100	4		4
4.3	SJSDC4MT17	Number Theory & Linear Algebra	4	20	80	100	4		4
4.4	SJSDC4MT18	Numerical Analysis	4	20	80	100	4		4
4.5	SJSDC4AI19	Artificial Neural Network	3	15	60	75	3		3
4.6	SJSDC4ST20(P)	Testing and Analysis using R (Lab)	2	15	60	75		2	2
4.7	SJSDC4AI21(P)	Artificial Neural Network (Lab)	4	20	80	100		4	4
4.8	SJSDC4AI18	Mini project	5	20	80	100		5	5
4.9		Gender studies / Gerontology	4*						
		Semester IV total	**30**	**150**	**600**	**750**	**18**	**11**	**30**
Semester V									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
5.1	SJSDC5MT19	Abstract Algebra	4	20	80	100	4		4
5.2	SJSDC5MT20	Real Analysis	4	20	80	100	4		4
5.3	SJSDC5MT21	Complex Analysis	4	20	80	100	4		4
5.4		Elective	4	20	80	100	4		4
5.5	SJSDC5AI23	Deep learning	3	15	60	75	3		3
5.6	SJSDC5AI24	Physical Programming and Internet of Things	3	15	60	75	3		3
5.7	SJSDC5AI25(P)	Deep learning (Lab)	4	20	80	100		4	4
5.8	SJSDC5AI26(P)	Physical Programming and Internet of Things (Lab)	4	20	280	100		4	4
		Semester V total	**30**	**150**	**600**	**750**	**22**	**8**	**30**
Semester VI									
C.No	**Course Code**	**Course Name**	**Credit**	**Marks**			**Hrs/week**		
				Int	**Ext**	**total**	**Th**	**Prac**	**Total**
6.1	SJSDC6AI27	Term Paper	2	50	--	50	0	900 Hrs	900 Hrs
6.2	SJSDC6AI28	Internship and Project — Internship	28	40	160	200			
		Project		40	160	200			
		Semester VI total	**30**	**130**	**320**	**450**		**30**	**30**
		Grand Total	**180**			**4200**			

Elective Courses	
SJSDC5E01	Natural Language Processing and Computer Vision
SJSDC5E02	Big Data Analytics
SJSDC5E03	Graph Theory
SJSDC5E04	Linear Programming

Component		Total Credits		
General Component	English	14 (T)	38 (T)	180
	Language	8 (T)		
	General Paper	16 (T)		
Skill Component	Statistics	8(T)+4(P)	142 71 (T)+ 71 (P)	
	Mathematics	36 (T)		
	Artificial Intelligence	23 (T)+27(P)		
	Elective	4 (T)		
	Mini Project/ Project/Internship	40 (P)		

*** T- Theory, P- Practical**

CREDIT SYSTEM

A student is required to acquire a total of **180** credits for the completion of the programme which shall be counted for SGPA and CGPA.

Extra Credits: 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. 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 Calicut University Social Service Programme (CUSSP). Extra credits are not counted for SGPA or CGPA.

ADMISSION

ELIGIBILITY

a) The admission to a B Voc programme will be as per the rules and regulations of the University for UG admissions.
b) The eligibility criteria for admission shall be as announced by the University/College from time to time.
c) Basic eligibility for B.Voc. Mathematics and Artificial Intelligence is 10+2 and above with Mathematics as one of the core subject (No age limit).
h) Grace Marks may be awarded to a student for meritorious achievements in co-curricular activities such as Sports/Arts/ NSS/NCC/ Student Entrepreneurship.
i) Index mark calculations will be decided by the Board of Studies

RESERVATION

The reservation rules for Government/Aided Colleges are as same as that of the regular UG programmes conducted in colleges affiliated to university of Calicut.

MULTIPLE ENTRY:

Students who discontinued after the successful completion of second semester with Diploma (NSQF Level 5) or fourth semester with Advance Diploma (NSQF Level 6) can rejoin to the programme and opt for a lateral entry to third semester or to fifth semester respectively later if wish to do so and can finish their B.Voc Degree with NSQF Level (7). In such cases, the multiple entry shall be completed within 6 years from the date of first registration of the programme.

When Re-joining through multiple entry, the following points to be considered:

1. Re-joining the programme will be allowed to only if the candidate has secured a minimum CGPA of 2.5.
2. The candidate should remit the fees prevailing at that time.
3. B. Voc Governing Council in the institution will take the decision regarding the re joining

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 EVALUATION

Theory		Practical	
Test paper	40%	Record	40%
Assignment	20%,	Lab Involvement	60%
Seminar	20%		
CRP based on attendance	20%.		

For the test paper marks, at least two test paper will be conducted. If more test papers are conducted, the mark of the best two will be taken. There shall not be any chance for improvement for internal marks.

Split up of marks for test papers

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 Classroom Participation (CRP)

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

The external question papers may be of uniform pattern with 80/60 marks 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.

Evaluation of Practical

The external examination in practical courses shall be conducted by two examiners – one internal and an external. evaluation and viva-voce shall be done by the external examiner. The practical board meeting should be conducted before conducting the external practical examination with the concerned examiners. The instructions for conducting the practical examinations, the mark distribution, question paper distribution and related matters should be discussed in the practical examination board meeting. The scheme of valuation must be strictly followed so as to ensure uniformity.

Evaluation of Mini Project/Project and Internship

Internship or the major projector or minor project should be carried out in the industry, not necessarily with industry partner. The major idea for internship is to implement the things learned and to get a real life experience. Every student will be assigned an internal guide, allotted from the parent department concerned or an expert available in the college appointed by the principal or the head of the department. For mini project, a group of maximum 5 students can be assigned a single work.The student has to make regular discussions with the guide while choosing the subject/area and throughout the life time of the project. At least three reviews should be conducted to evaluate the progress of work. An evaluation team is constituted for conducting the evaluation. The team consist of external examiner,

representative from the industry and a faculty. Students should submit a report of their work. A valid certificate of internship from the organization should be produced as a proof that the work is carried out in the respective organization. Students are required to make the presentations of their work to present before the panel of examiners. A viva will be conducted based on the report and students are supposed to clarify the queries regarding their work.

Mark distribution for internship

Distribution	External Assessment Marks	Internal Assessment Marks
Report	100	30
Viva	60	10
Total	**160**	**40**

Mark distribution for Project

Marks Distribution	Total marks	Internal Assessment Marks
Theory/ Algorithm/Flow diagram	40	5
Implementation	80	20
Result/Output	20	5
Record	10	5
Viva	10	5
Total	**160**	**40**

Mark distribution of Mini-project

Mark Distribution	Total Marks	Internal Assessment Marks
Theory/ Algorithm/ Flow Diagram	20	2
Implementation	40	10
Result/Output	10	2
Record	5	2
Viva	5	4
Total	80	20

Evaluation of Audit courses: The examination shall be conducted by the college itself .The Question paper shall be of 100 marks of 3 hour duration.

Evaluation of Term Paper: The term paper shall be in the sixth semester along with internship and project. It should be in the standard format which is eligible for publishing. It has no external evaluation but only internal assessment.

Minimum for pass

The successful completion of all the courses prescribed for the diploma/degree programme with

P grade shall be the minimum requirement for the award of diploma/degree

Notes:
1. For Project/internship, the minimum for a pass shall be 50% of the total marks assigned to the respective examination.
2. A student who does not secure this pass marks in a subject will have to repeat the respective subject.
3. If a candidate has passed all examinations of B.Voc. Programme (at the time of publication of results of last semester) except Internship and Project in the last semester, a re-examination for the same should be conducted within one month after the publication of results. Each candidate should apply for this Save-A-Year examination within one week after the publication of last semester results.

INDIRECT GRADING SYSTEM

a. Indirect grading System based on a 10-point scale is used to evaluate the performance of students.
b. 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. (Annexure I).
c. 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 are not displayed in the grade card.
d. 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

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

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

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.

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

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

METHOD OF INDIRECT GRADING

Evaluation (both internal and external) is carried out using Mark system .The Grade on thebasis 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:

Ten Point Indirect Grading System

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	ThirdClass
Below 35	F	Failure	0	0	Fail
Incomplete	I	Incomplete	0	0	Fail
Absent	Ab	Absent	0	0	Fail

Example – 1 SGPA Calculation

SemesterI Course Code	Course Name	Grade Obtained	Grade point (G)	Credit (C)	Credit point (CXG)	
xxxxxxx	Xxxxxxx	A	8	4	32	
xxxxxxx	Xxxxxxxxx	C	5	4	20	
xxxxxxx	Xxxxxxxxx	A+	9	4	36	
xxxxxxx	Xxxxxxxxx	B+	7	3	21	
xxxxxxx	Xxxxxxxx	P	4	3	20	
xxxxxxx	Xxxxxxxx	C	9	6	54	
xxxxxxx	Xxxxxxxx	C	9	6	54	

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

$$\text{SGPA} = \frac{32+20+36+21+20+54+54}{30} = \frac{237}{30}$$

SGPA = 7.900

Percentage of marks of semester I = (SGPA/10) x 100 = 79.00 %

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

Example: 2

SemesterII Course Code	Course Name	Grade Obtained	Grade point (G)	Credit (C)	Credit point (CXG)	
xxxxxxx	Xxxxxxx	A	8	4	32	
xxxxxxx	Xxxxxxxxx	C	5	4	20	
xxxxxxx	Xxxxxxxxx	A+	9	4	36	
xxxxxxx	Xxxxxxxxx	B+	7	3	21	
xxxxxx*	Xxxxxxxx	F	0	3	0	
xxxxxxx	Xxxxxxxx	C	5	6	30	
xxxxxxx	Xxxxxxxx	C	5	6	30	

*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

$$\text{CGPA} = \frac{\textit{Total Credit points obtained in six semesters}}{\textit{Total Credits acquired (180)}}$$

Example

CGPA = (136 + 145 + 161 + 248 + 231 + 237) / 180 = 1158/180

CGPA = 6.433

Total percentage of marks = (CGPA/10)*100

Total percentage of marks = (6.433/10)*100 = 64.33

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

Similarly CGPA of Skill Development Components, General Education Components like EnglishCommon 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.

QUESTION PAPER PATTERN

Scheme of Examinations:

The external QP with 80 marks and Internal examination is of 20 marks. Duration of each external examination is 2.5 Hrs. The pattern of External Examination is as givenbelow. The students can answer all the questions in Sections A&B. But there shall beCeiling in each section.

Section A

Short answer type carries 2 marks each - 15 questions — Ceiling - 25

Section B

Paragraph/ Problem type carries 5 marks each - 8 questions — Ceiling - 35

Section C

Essay type carries 10 marks (2 out of 4) — 2X10 = 20

Total — 80

Question paper type 2

Scheme of Examinations:

The external QP with 60 marks and Internal examination is of 15 marks. Duration of each external examination is 2 Hrs. 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 marks each - 12 questions — Ceiling - 20

Section B

Paragraph/ Problem type carries 5 marks each - 7 questions — Ceiling - 30

Section C

Essay type carries 10 marks (1 out of 2) — 1X10= 10

Total — 60

AWARD OF DEGREE

The successful completion of all the courses (General Education Components, Skill Development Components and Audit courses) prescribed for the degree programme with 'P' grade shall be the minimum requirement for the award of degree.

Levels of Awards

B. Voc is a programme with multiple exits. Following table shows the various certificates and their duration

Awards	Duration	NSQF Levels
Diploma	2 Semester	Level 5
Advanced Diploma	4 Semester	Level 6
B. Voc Degree	6 Semester	Level 7

a) Students are free to exit at any point in the duration of the programme.
b) Only those students who successfully complete the courses and clear the examination are eligible for the certificate.
c) Separate certificate will be awarded for each year for successful candidates. A candidate who successfully completes first two semesters shall be awarded a Diploma Certificate, first four semesters shall be awarded an Advanced Diploma Certificate and clearing all the semester shall be awarded B.Voc Degree certificate.
d) Students who fail in any course may be allowed to move the higher level but won't be eligible for any certificates until he/she clears previous courses
e) B. Voc degree will confer to those whose successfully complete the diploma, higher diploma and internship and project at the sixth semester.

B.Voc degree is recognised at par with other U.G Programme approved by University of Calicut

DETAILED SYLLABUS – SKILL COMPONENTS

STATISTICS

SEMESTER I

SJSDC1ST01- DESCRIPTIVE STATISTICS & INTRODUCTION TO R

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

1. Understanding of basics of R programming.
2. Summarize the data in a diagrammatic and graphic way.
3. Obtain descriptive statistics and make interpretations.
4. Describe the concepts of correlation and regression and identify an appropriate relationship between two variables.

Text	1. S.C. Gupta and V.K. Kapoor. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi 2. Sudha G Purohit, Shared D. Gore, Shailaja R ddeshmukh, Statistics Using R, Norosa publication

Syllabus

Module 1: 18 hours

Descriptive statistics

Classification of data, Frequency distributions, Diagrammatic representation of data: Bar diagram, Histogram, Ogive, Pi Chart, Measures of Central tendency: Mean, Median, Mode and other measures of central tendency, Partition values (Use R software to solve the problems

Module 2: 16 hours

Dispersion, Range, Mean deviation, Standard deviation, Coefficient of variation, Inter quartile range, Moments, Skewness and Kurtosis. (Use R software to solve the problems)

Module 3: 16 hours

Bivariate data: Positive and negative correlation, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's Rank Correlation.

Curve fitting: Principle of least squares: linear, parabolic and exponential, linear regression model, Relationship between correlation coefficient and regression coefficients (Use R software to solve the problems)

Module 4: 10 hours

Introduction to R: R as a statistical software and language, R preliminaries, Methods of data input, indexing, built in functions, graphics in R, Saving, storing and retrieving work.

References:

1	Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata
2	Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied
3	Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.
4	Chatfield.C. The Analysis of Time Series: An Introduction, Chapman & Hall
5	Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
6	The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Springer 2013
7	A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G.Meesters, Springer 2009

SEMESTER II

SJSDC2ST08(P) – DISCRIPTIVESTATISTICS USING R LAB

2 hours/week2 Credits 75Marks [Int:15+Ext:60]

Course Outcome

1. Applythe basics of R package
2. Apply Statistical tools for analysis of data in real time using R
3. Fit curves for a give data using R

Prac

1. Preparation of frequency table
    a. Discrete frequency table
    b. Continuous Frequency Table
2. Construction of Different types of Bar chart
    a. Simple bar chart
    b. Multiple Bar chart
    c. Subdivided bar chart
3. Construction of Pi Chart
4. Construction of Histogram
5. Construction of Ogives
6. Computation of measures of central tendency
    a. Mean, Median, Mode,
7. Computation of Percentiles
8. Computation of measures of Dispersion
    a. Range, M. D., S. D. (Variance), Inter-quartile range
9. Computation of correlation
    a. Plotting of scatter diagram
    b. Coefficient of correlation
    c. Rank correlation
10. Fitting of curve
    a. Simple linear regression
    b. Quadratic curve

SEMESTER III

SJSDC3ST11-PROBABILITY STATISTICAL METHODS

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

1. Summarize various probability approaches and compute probabilities.
2. Understand the applications of theoretical distributions and sampling distributions.
3. Identify a suitable test of significance to test a given hypothesis.
4. Apply the concept of time series.

Text	S.C. Gupta and V.K. Kapoor. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi

Sylla

Module 1: 16 hours

Introduction to Probability: Random experiment, Sample space, events, classical definition of probability, statistical regularity, axiomatic definition of probability and simple properties, addition theorem (two and three events), conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.

Module 2: 18 hours

Probability distribution:Random variables: Discrete and continuous, probability mass function (pmf) and probability density function (pdf)-properties and examples, Cumulative distribution function and its properties, change of variables (univariate case only) Discrete Distributions – Uniform, Binomial, Poisson, Geometric and Negative Binomial (Definition only) Continuous distributions – Normal, Standard normal, Uniform, Gamma and Exponential distributions (Only pmf/pdf defnition, mean and variance formulae, related problems). Sampling distributions – Chi-square, t and F distributions (Definition and interrelationships only)

Module 3: 18 hours

Testing of Hypothesis: Procedure for testing of hypothesis, Type of errors, p- value, Large sample tests – Test for single mean, equality of two means, test for single proportion, equality of two proportions. Small sample test t-test for single mean, unpaired and paired t-test. Chi-square test for variance, F-test for equality of variances Chi-square test for Goodness of fit, Test of independence and association of attributes. Testing means of several populations: one -way ANOVA, two-way ANOVA (Use R software commands to solve problems)

Module 4: 8 hours

Time series: Introduction and examples of time series from various fields, Components of times series, Additive and Multiplicative models. Trend: Estimation of trend by free hand curve method, method of semi averages, method of moving averages and fitting various mathematical curves. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend.

References:

1	Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2nd Edn. (Reprint) John Wiley and Sons.
2	Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd
3	John E Freund, Mathematical Statistics, Pearson Edn, New Delhi
4	Cochran W.G. (1984):Sampling Techniques(3rd Ed.), Wiley Eastern.
5	Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
6.	. Hoel P.G. *Introduction to mathematical statistics*, Asia Publishing house. 4. Sudha G Purohit, Shared D. Gore, Shailaja R ddeshmukh, Statistics Using R, Norosa publication
7	The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Springer 2013
8.	A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009

SEMESTER IV

SJSDC4ST20(P) - TESTING AND ANALYSIS USING R (Lab)

2 hours/week2 Credits 75 Marks [Int:15+Ext:60]

Course Outcome

1. Apply testing procedure in real life problems
2. Develop scientific and experimental skills of the students with application based studies.
3. Correlate the theoretical principles with application based studies.

Prac

1. Plot the pdf of probability distributions with various parameters.
2. Large sample testing - Z test
    a. Test for mean
    b. Test for proportion
3. Small sample testing
    a. Unpaired and paired t – test
    b. F- test
4. Goodness of fit test and test of independence.
5. One-way ANOVA
6. Two-way ANOVA
7. Calculating Moving averages.
8. Fitting of linear trend
9. Fitting of polynomial trend of order two
10. Fitting of an exponential trend

MATHEMATICS

FIRST SEMESTER

SJSDC1MT02 CALCULUS OF SINGLE VARIABLE-1

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

CO1 Understand to the fundamental ideas of limit, continuity and differentiability and also to some basic theorems of differential calculus

CO2 Apply differential calculus for sketching of curves and in the solution of some optimization problems of interest in real life

CO3 Evaluate the definite integral

CO4 Solve the area, Volume, surface area problem , find out the arc length of a plane curve

Sylla

Text	Calculus: Soo T Tan Brooks/Cole, Cengage Learning (2010) ISBN: 978-0-534-46579-7

Module-I (15hrs)

0.2: Functions and their Graphs- Definition of a Function, Describing Functions, Evaluating Functions, Finding the Domain of a Function, The Vertical Line Test, Piecewise Defined Functions, Even and Odd Functions (quick review)

0.4: Combining functions- Arithmetic Operations on Functions, Composition of Functions, Graphs of Transformed Functions, Vertical Translations, Horizontal Translations, Vertical Stretching and Compressing, Horizontal Stretching and Compressing, Reflecting

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*, 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

1.5 : Tangent Lines and Rate of change- An Intuitive Look, Estimating the Rate of Change of a Function from Its Graph, More Examples Involving Rates of Change, Defining a Tangent Line, Tangent Lines, Secant Lines, and Rates of Change

2.1: The Derivatives- Definition, Using the Derivative to Describe the Motion of the Maglev, Differentiation, Using the Graph of f to Sketch the Graph of f' Differentiability, Differentiability and Continuity

2.4: The role of derivative in the real world- Motion Along a Line, Marginal Functions in Economics

2.9: Differentials and Linear Approximations– increments, Differentials, Error Estimates, Linear Approximations, Error in Approximating Δy by dy

Module-II (15 hrs)

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 f' 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 (15 hrs)

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 hrs)

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

5.1: 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,

References:

1	Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018) ISBN 0134438981
2	Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
3	Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015) ISBN: 1319116450
4	Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc.(2016) ISBN: 1118883764
5	James Stewart : Calculus (8/e) Brooks/Cole Cengage Learning(2016) ISBN: 978- 1-285-74062-1
6	Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY (1985) ISBN 0-387-90974-5 : ISBN 0-387-90975-3

SECOND SEMESTER

SJSDC2MT06 CALCULUS OF SINGLE VARIABLE-2

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1	Understand natural algorithm, exponential function, hyperbolic function and its properties
CO2	Solve improper integrals and find their convergence
CO3	Understand Series convergence and find the convergence using different tests
CO4	Find power series convergence, region of convergence, differentiation and integration
CO5	Understand the concept of parameterization and find arc length, curvature, area of surface of revolution using it

Sylla

Text	Calculus: Soo T Tan Brooks/Cole, Cengage Learning (2010) ISBN: 978-0-534-46579-7

Module-I (15 hrs)

(The Transcendental Functions)

6.1: The Natural logarithmic function- definition, The Derivative of $ln\ x$, Laws of Logarithms, The Graph of the Natural Logarithmic Function, The Derivatives of Logarithmic Functions, Logarithmic Differentiation, Integration Involving Logarithmic Functions

6.2: Inverse Functions-The Inverse of a Function, The Graphs of Inverse Functions, Which Functions have Inverses?, Finding the Inverse of a Function, Continuity and Differentiability of Inverse Functions.

6.3: Exponential Functions- The number e , Defining the Natural Exponential Function, properties, The Laws of Exponents, The Derivatives of Exponential Functions, Integration of the Natural Exponential Function

6.4: General Exponential and Logarithmic Functions - Exponential Functions with Base a, laws of exponents, The Derivatives of a^x,a^u, Graphs of y= a^x, integrating a^x , Logarithmic Functions with Base a, change of base formula, The Power Rule (General Form), The Derivatives of Logarithmic Functions with Base a , The Definition of the Number e as a Limit ['Compound Interest' omitted]

6.5: Inverse trigonometric functions- definition, graph, inverse properties, Derivative of inverse trigonometric functions, Integration Involving Inverse Trigonometric Functions

6.6: Hyperbolic functions- The Graphs of the Hyperbolic Functions, Hyperbolic Identities, Derivatives and Integrals of Hyperbolic Functions, Inverse Hyperbolic Functions, representation in terms of logarithmic function, Derivatives of Inverse Hyperbolic Functions, An Application

6.7: Indeterminate forms and L'Hospital rule- motivation, The Indeterminate forms 0/0 and ∞/∞, the indeterminate forms $\infty - \infty$, $0.\infty$, 0^0, ∞^0 *and* 1^∞

Module-II (15 hrs)

(Infinite Sequences and Series)

7.6: Improper integrals – definition, Infinite Intervals of Integration, Improper Integrals with Infinite Discontinuities, A Comparison Test for Improper Integrals

9.1: Sequences- definition, recursive definition, Limit of a Sequence, limit laws, squeeze theorem, Bounded Monotonic Sequences, definition, monotone convergence theorem (only statement; its proof omitted)

9.2: Series- defining the sum, convergence and divergence, Geometric Series, The Harmonic Series, The Divergence Test, Properties of Convergent Series

9.3 : The Integral Test – investigation of convergence ,integral test, The p- Series, its convergence and divergence

9.4 : The Comparison Test- test series, The Comparison Test, The Limit Comparison Test

9.5 : Alternating Series- definition, the alternating series test, its proof, examples, Approximating the Sum of an Alternating Series by S_n

9.6 : Absolute Convergence- definition, conditionally convergent, The Ratio Test, The Root Test, Summary of Tests for Convergence and Divergence of Series, Rearrangement of Series

Module-III (15 hrs)

9.7 : Power Series- definition, Interval of Convergence, radius of convergence, Differentiation and Integration of Power Series

9.8 : Taylor and Maclaurin Series- definition, Taylor and Maclaurin series of functions, Techniques for Finding Taylor Series

10.2 : Plane Curves and Parametric Equations- Why We Use Parametric Equations, Sketching Curves Defined by Parametric Equations

10.3 : The Calculus of parametric equations- Tangent Lines to Curves Defined by Parametric Equations, Horizontal and Vertical Tangents, Finding from $\frac{d^2y}{dx^2}$ Parametric Equations, The Length of a Smooth Curve, The area of a surface of revolution

10.4 : Polar coordinate-The Polar Coordinate System, Relationship Between Polar and Rectangular Coordinates, Graphs of Polar Equations, Symmetry, Tangent Lines to Graphs of Polar Equations

10.5 :Areas and Arc Lengths in polar coordinates-Areas in Polar Coordinates, area bounded by polar curves, Area Bounded by Two Graphs, Arc Length in Polar Coordinates, Area of a Surface of Revolution, Points of Intersection of Graphs in Polar Coordinates

Module-IV (15 hrs)

11.5 : Lines and Planes in Space-Equations of Lines in Space, parametric equation, symmetric equation of a line, Equations of Planes in Space, standard equation, Parallel and Orthogonal Planes, The Angle Between Two Planes, The Distance Between a Point and a Plane

11.6 : Surfaces in Space- Traces, Cylinders, Quadric Surfaces, Ellipsoids, Hyperboloids of One Sheet, Hyperboloids of Two Sheets, Cones, Paraboloids, Hyperbolic Paraboloids

11.7 : Cylindrical and Spherical Coordinates-The Cylindrical Coordinate System, converting cylindrical to rectangular and vice verse, The Spherical Coordinate System, converting spherical to rectangular and vice verse,

12.1 : Vector Valued functions and Space Curves- definition of vector function, Curves Defined by Vector Functions, ['Example 7' omitted] Limits and Continuity

12.2 :Differentiation and Integration of Vector-Valued Function- The Derivative of a Vector Function, Higher-Order Derivatives, Rules of Differentiation, Integration of Vector Functions,

12.3 : Arc length and Curvature- Arc Length of a space curve, Smooth Curves, Arc Length Parameter, arc length function, Curvature, formula for finding curvature, Radius of Curvature,

12.4 : Velocity and Acceleration- Velocity, Acceleration, and Speed; Motion of a Projectile

12.5 : Tangential and Normal Components of Acceleration- The Unit Normal, principal unit normal vector, Tangential and Normal Components of Acceleration [The subsections ' Kepler's Laws of Planetary Motion ', and ' Derivation of

Kepler's First Law' omitted]

References:

1	Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus (14/e) Pearson(2018) ISBN 0134438981
2	Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
3	Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015) ISBN: 1319116450
4	Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc.(2016) ISBN: 1118883764
5	James Stewart : Calculus (8/e) Brooks/Cole Cengage Learning(2016) ISBN: 978-1-285-74062-1
6	Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY(1985) ISBN 0-387-90974-5 : ISBN 0-387-90975-3

THIRD SEMESTER

SJSDC3MT12 CALCULUS OF MULTIVARIABLE

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1	Understand several contexts of appearance of multivariable functions and their representation using graph and contour diagrams.
CO2	Formulate and work on the idea of limit and continuity for functions of several variables.
CO3	Understand the notion of partial derivative, their computation, interpretation and chain rule for calculating partial derivatives.
CO4	Get the idea of directional derivative, its evaluation, interpretation, and relationship with partial derivatives.
CO5	Understand the concept of gradient, a few of its properties, application and interpretation.
CO6	Understand the use of partial derivatives in getting information of tangent plane and normal line.
CO7	Calculate the maximum and minimum values of a multivariable function using second derivative test and Lagrange multiplier method.
CO8	Find a few real life applications of Lagrange multiplier method in optimization problems.
CO9	Extend the notion of integral of a function of single variable to integral of functions of two and three variables.
CO10	Address the practical problem of evaluation of double and triple integral using Fubini's theorem and change of variable formula.
C11	Realise the advantage of choosing other coordinate systems such as polar, spherical, cylindrical etc. in the evaluation of double and triple integrals .
C12	Apply double and triple integral in the problem of finding out surface area ,mass of lamina, volume, centre of mass and so on.
C13	Understand the notion of a vector field, the idea of curl and divergence of a vector field, their evaluation and interpretation.
C14	Understand the idea of line integral and surface integral and their evaluations.
C15	Learn three major results viz. Green's theorem, Gauss's theorem and Stokes' theorem of multivariable calculus and their use in several areas and directions.

Text	Calculus: Soo T Tan Brooks/Cole, Cengage Learning (2010) ISBN 0- 534-46579-X)

Module-I (15 hrs)

13.1 : Functions of two or more variables- Functions of Two Variables,

Graphs of Functions of Two Variables, Level Curves, Functions of Three Variables and Level Surfaces

13.2 : Limits and continuity-An Intuitive Definition of a Limit, existence and non existence of limit, Continuity of a Function of Two Variables, Continuity on a Set, continuity of polynomial and rational functions, continuity of composite functions, Functions of Three or More Variables, The $\varepsilon - \delta$ Definition of a Limit

13.3 : Partial Derivatives- Partial Derivatives of Functions of Two Variables, geometric interpretation, Computing Partial Derivatives, Implicit Differentiation, Partial Derivatives of Functions of More Than Two Variables, Higher-Order Derivatives, clairaut theorem, harmonic functions

13.4 : Differentials- Increments, The Total Differential, interpretation, **Error in Approximating Δz by** dz [only statement of theorem1 required ; proof omitted] Differentiability of a Function of Two Variables, criteria, Differentiability and Continuity, Functions of Three or More Variables

13.5 : The Chain rule- The Chain Rule for Functions Involving One Independent Variable, The Chain Rule for Functions Involving Two Independent Variables, The General Chain Rule, Implicit Differentiation

Module-II (15 hrs)

13.6 : Directional Derivatives and Gradient vectors - The Directional

Derivative, The Gradient of a Function of Two Variables, Properties of the Gradient, Functions of Three Variables

13.7 : Tangent Planes and Normal Lines- Geometric Interpretation of the Gradient, Tangent Planes and Normal Lines, Using the Tangent Plane of f to approximate the Surface $z = f(x, y)$

13.8 : Extrema of Functions of two variables - Relative and Absolute Extrema,

Critical Points—Candidates for Relative Extrema, The Second Derivative Test for Relative Extrema, Finding the Absolute Extremum Values of a Continuous Function on a Closed Set

13.9 : Lagrange Multipliers- Constrained Maxima and Minima, The Method of Lagrange Multipliers, Lagrange theorem, Optimizing a Function Subject to Two Constraints

Module-III (15 hrs)

14.1 : Double integrals- An Introductory Example, Volume of a Solid Between a Surface and a Rectangle, The Double Integral Over a Rectangular Region, Double Integrals Over General Regions, Properties of Double Integrals

14.2 : Iterated Integrals-Iterated Integrals Over Rectangular Regions, Fubini's Theorem for Rectangular Regions, Iterated Integrals Over Nonrectangular Regions, y- simple and x- simple regions, advantage of changing the order of integration

14.3 :Double integrals in polar coordinates- Polar Rectangles, Double Integrals Over Polar Rectangles, Double Integrals Over General Regions, r- simple region, method of evaluation

14.4 : Applications of Double integral- Mass of a Lamina, Moments and Center of Mass of a Lamina, Moments of Inertia, Radius of Gyration of a Lamina

14.5 : Surface Area- Area of a Surface $z = f(x, y)$, Area of Surfaces with Equations $y = g(x, z)$ and $x = h(y, z)$

14.6 : Triple integrals- Triple Integrals Over a Rectangular Box, definition, method of evaluation as iterated integrals, Triple Integrals Over General Bounded Regions in Space, Evaluating Triple Integrals Over General Regions, evaluation technique, Volume, Mass, Center of Mass, and Moments of Inertia

14.7 : Triple Integrals in cylindrical and spherical coordinates- evaluation of integrals in Cylindrical Coordinates, Spherical Coordinates

14.8 : Change of variables in multiple integrals- Transformations, Change of Variables in Double Integrals [only the method is required; derivation omitted],

illustrations, Change of Variables in Triple Integrals

Module-IV (15 hrs)

15.1 : Vector Fields- V.F. in two and three dimensional space, Conservative Vector Fields

15.2 : Divergence and Curl- Divergence- idea and definition, Curl- idea and definition

15.3 : Line Integrals- Line integral w.r.t. arc length-motivation, basic idea and definition, Line Integrals with Respect to Coordinate Variables, orientation of curve Line Integrals in Space, Line Integrals of Vector Fields

15.4 : Independence of Path and Conservative Vector Fields-path independence through example, definition, fundamental theorem for line integral, Line Integrals Along Closed Paths, work done by conservative vector field, Independence of Path and Conservative Vector Fields, Determining Whether a Vector Field Is Conservative, test for conservative vector field Finding a Potential Function, Conservation of Energy

15.5 : Green's Theorem- Green's Theorem for Simple Regions, proof of theorem for simple regions, finding area using line integral, Green's Theorem for More General Regions, Vector Form of Green's Theorem

15.6 : Parametric Surfaces-Why We Use Parametric Surfaces, Finding Parametric Representations of Surfaces, Tangent Planes to Parametric Surfaces, Area of a Parametric Surface [derivation of formula omitted]

15.7 : Surface Integrals-Surface Integrals of Scalar Fields, evaluation of surface integral for surfaces that are graphs , [derivation of formula omitted; only method required] Parametric Surfaces, evaluation of surface integral for parametric surface, Oriented Surfaces, Surface Integrals of Vector Fields- definition, flux integral, evaluation of surface integral for graph[method only], Parametric Surfaces, evaluation of surface integral of a vector field for parametric surface [method only]

15.8 : The Divergence Theorem-divergence theorem for simple solid regions (statement only), illustrations, Interpretation of Divergence

15.9 : Stokes Theorem-generalization of Green's theorem –Stokes Theorem, illustrations, Interpretation of Curl

References:

1	JoelHass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson(2018) ISBN 0134438981
2	Robert A Adams & Christopher Essex : Calculus: A complete Course (8/e) Pearson Education Canada (2013) ISBN: 032187742X
3	Jon Rogawski: Multivariable Calculus Early Transcendentals (2/e) W. H. Freeman and Company(2012) ISBN: 1-4292-3187-4
4	Anton, Bivens & Davis : Calculus Early Transcendentals (10/e) John Wiley & Sons, Inc.(2012) ISBN: 978-0-470-64769-1
5	James Stewart : Calculus (8/e) Brooks/Cole Cengage Learning(2016) ISBN: 978-1-285-74062-1
6	Jerrold E. Marsden & Anthony Tromba :Vector Calculus (6/e) W. H. Freeman and Company ,New York(2012) ISBN: 978-1-4292-1508-4
7	Arnold Ostebee & Paul Zorn: Multivariable Calculus (2/e) W. H. Freeman Custom Publishing, N.Y.(2008)ISBN: 978-1-4292-3033-9

THIRD SEMESTER

SJSDC3MT13 DIFFERENTIAL EQUATIONS

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Identify a number of areas where the modelling process results in a differential equation.

CO2 Learn what an ODE is, what it means by its solution, how to classify DEs, what it means by an IVP and so on.

CO3 Learn to solve ODEs that are in linear, separable and in exact forms and also to analyse the solution.

CO4 Realise the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.

CO5 Learn a method to approximate the solution successively of a first order IVP.

CO6 Understand the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.

CO7 Find out a series solution for homogeneous equations with variable coefficients near ordinary points.

CO8 Solve differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.

CO9 Solve partial differential equations using the method of separation of variables

Syllabus

Text	Elementary Differential Equations and Boundary Value Problems (11/e): William E Boyce, Richard C Diprima And Douglas B Meade *John Wiley & Sons(2017) ISBN: 1119169879*

Module-I (20 hrs)

1.1: Some Basic Mathematical Models; Direction Fields

1.2: Solutions of some Differential equations

1.3: Classification of Differential Equations

2.1: Linear Differential Equations; Method of Integrating Factors

2.2: Separable Differential Equations

2.3 : Modelling with First Order Differential Equations

2.4 : Differences Between Linear and Nonlinear Differential Equations

2.6: Exact Differential Equations and Integrating Factors

2.8: The Existence and Uniqueness Theorem (proof omitted)

Module-II (20 hrs)

3.1: Homogeneous Differential Equations with Constant Coefficients

3.2: Solutions of Linear Homogeneous Equations; the Wronskian

3.3: Complex Roots of the Characteristic Equation

3.4 : Repeated Roots; Reduction of Order

3.5 : Nonhomogeneous Equations; Method of Undetermined Coefficients

3.6: Variation of Parameters

Module-III (12 hrs)

6.1: Definition of the Laplace Transform

6.2: Solution of Initial Value Problems

6.3: Step Functions

6.5 : Impulse Functions

6.6 : The Convolution Integral

Module-IV (8 hrs)

10.1: Two-Point Boundary Value Problems

10.2: Fourier Series

10.3: The Fourier Convergence Theorem

References:

1	Dennis G Zill &Michael R Cullen: Differential Equations with Boundary Value Problems(7/e):Brooks/Cole Cengage Learning(2009)ISBN: 0-495-10836-7
2	R Kent Nagle, Edward B. Saff & Arthur David Snider: Fundamentals of Differential Equations(8/e) Addison-Wesley(2012) ISBN: 0-321-74773-9
3	C. Henry Edwards &David E. Penney: Elementary Differential Equations (6/e) Pearson Education, Inc. New Jersey (2008) ISBN 0-13-239730-7

4	John Polking, Albert Boggess & David Arnold : Differential Equations with Boundary Value Problems(2/e) Pearson Education, Inc New Jersey(2006) ISBN 0-13-186236-7
5	Henry J. Ricardo: A Modern Introduction to Differential Equations(2/e) Elsevier Academic Press(2009)ISBN: 978-0-12-374746-4

FOURTH SEMESTER

SJSDC4MT17 NUMBER THEORY AND LINEAR ALGEBRA

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Prove results involving divisibility, greatest common divisor, least common multiple and a few applications

CO2 Understand the theory and method of solutions of LDE.

CO3 Understand the theory of congruence and a few applications.

CO4 Apply basic ideas of matrix theory to solve related problems

CO5 Understand Real vector spaces, subspaces, linear independence, basis and dimension

CO6 Understand row space , column space, null space

CO7 Find Rank nullity Eigen value & Eigen vectors of Matrix spaces

Syllabus

Text David M. Burton : Elementary Number Theory, Sixth Edn.,
Howard Anton & Chris Rorres: Elementary Linear Algebra, Application Version (11/e)

(Note: More concentration can be given on problems)

Module-I (12 hrs)

Number Theory (Text 1)

2.2 Divisibility theory in the integers – the division algorithm,

2.3 The greatest common divisor, the Euclidean algorithm,

2.4 The Diophantine equation ax + by = c.

2.5 Primes and their distribution.

4.2 The theory of congruences. Basic properties of congruence.

4.3 Binary and decimal representation of integers.

4.4 Linear congruences and Chinese remainder theorem.

4.5 Fermat's little theorem

Module-II (15 hrs)

Linear Algebra (Text 2)

1.1 Introduction to Systems of Linear Equations

1.2 Gaussian Elimination

1.3 Matrices and Matrix Operations

1.4 Inverses; Algebraic Properties of Matrices

1.5 Elementary Matrices and a Method for Finding

2.1 Determinants by Cofactor Expansion

2.2 Evaluating Determinants by Row Reduction

Module-III (15 hrs)

4.1 Real Vector Spaces 183

4.2 Subspaces 191

4.3 Linear Independence 202

4.4 Coordinates and Basis 212

4.5 Dimension 221

Module-IV (18 hrs)

4.6 Change of Basis 229

4.7 Row Space, Column Space, and Null Space 237

4.8 Rank, Nullity, and the Fundamental Matrix Spaces

4.9 Basic Matrix Transformations in R2 and R3

4.10 Properties of Matrix Transformations

5.1 Eigenvalues and Eigenvectors

References:

1	C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.
2	Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3	George E. Andrews : Number Theory, HPC
4	Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5	Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition
6	Devi Prasad : Elementary Linear Algebra, Narosa Pub. House

FOURTH SEMESTER

SJSDC4MT18 NUMERICAL ANALYSIS

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.

CO2 Understand the concept of interpolation and also learn some well known interpolation techniques.

CO3 Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.

CO4 Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.

Syllabus

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

Module-I (12 hrs)

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

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

Interpolation and Polynomial Approximation

Module-II (12 hrs)

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

3.2 : Data Approximation and Neville's Method- motivation, Neville's Method, recursive method to generate Lagrange polynomial approximations.

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.

Module-II (18 hrs)

Numerical Differentiation and Integration

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

4.4 : Composite Numerical Integration-composite Simpson's rule, composite, trapezoidal rule, composite midpoint rule, round off error stability

Module-III (18 hrs)

Initial-Value Problems for Ordinary Differential Equations

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]

References:

1	Kendall E. Atkinson, Weimin Han: Elementary Numerical Analysis(3/e) John Wiley & Sons(2004) ISBN:0-471-43337-3[Indian Edition by Wiley India ISBN: 978-81-265-0802-0]
2	James F. Epperson: An Introduction to Numerical Methods and Analysis(2/e) John Wiley & Sons(2013)ISBN: 978-1-118-36759-9
3	Timothy Sauer: Numerical Analysis(2/e) Pearson (2012) ISBN: 0-321-78367-0
4	S S Sastri : Introductory Methods of Numerical Analysis(5/e) PHI Learning Pvt. Ltd.(2012) ISBN:978-81-203-4592-8
5	Ward Cheney,David Kincaid : Numerical Mathematics and Computing (6/e) Thomson Brooks/Cole(2008) ISBN: 495-11475-8
6	James C Robinson: An Introduction to Ordinary Differential Equations Cambridge University Press (2004)ISBN: 0-521-53391-0

FIFTH SEMESTER

SJSDC5MT19 ABSTRACT ALGEBRA

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Understand concepts of permutations, groups, subgroups and solve problems related to it

CO2 Understand cyclic groups, permutation groups, cosets, commutative rings, Integral domains and learn basic theorems related to the concepts

CO3 Understand the concept of Isomorphims, homomorphism and learn basic theorems related to the concepts

Syllabus

Text	Abstract Algebra(3/e):John A Beachy and William D Blair Waveland Press, Inc.(2006) ISBN: 1-57766-443-4

Module-II Text (2)

3.1: Definition of Group-binary operation, uniqueness of identity and inverse, definition and examples of groups, properties, Abelian group, finite and infinite groups, general linear groups

3.2: Subgroups-the notion of subgroup, examples, conditions for a subgroup, cyclic subgroups, order of an element, Lagrange theorem, Euler's theorem

3.3: constructing examples- groups with order upto 6, multiplication table, product of subgroups, direct products, Klein four group as direct product, subgroup generated by a subset

Module-II (15 hrs)

3.4: Isomorphism – definition, consequences, structural properties, method of showing that groups are not isomorphic, isomorphic and non isomorphic groups.

3.5 : Cyclic groups- subgroups of cyclic groups, characterisation, generators of a finite cyclic group, structure theorem for finite cyclic group, exponent of a group, characterisation of cyclic groups among finite abelian groups.

3.6 : Permutation groups- definition, Cayley's theorem, rigid motions of n-gons, dihedral group, alternating group

Module-III (15 hrs)

3.7 : Homomorphism - basic idea, examples, definition, properties, kernel, normal subgroups, subgroups related via homomorphism

3.8 : Cosets- left and right cosets, normal subgroups and factor groups, fundamental homomorphism theorem, simple groups, examples and illustrations of concepts

Module-IV (15 hrs)

7.1: (Structure of Groups) Isomorphism theorems; Automorphism- first isomorphism theorem, second isomorphism theorem, inner automorphism

5.1 : Commutative Rings ; Integral Domains- definition, examples, subring, criteria to be a subring, divisor of zero, integral domain, finite integral domain.

References:

1	Joseph A. Gallian : Contemporary Abstract Algebra(9/e) Cengage Learning, Boston(2017) ISBN: 978-1-305-65796-0
2	John B Fraleigh : A First Course in Abstract Algebra(7/e) Pearson Education LPE(2003) ISBN 978-81-7758-900-9
3	David Steven Dummit, Richard M. Foote: Abstract Algebra(3/e) Wiley, (2004) ISBN: 8126532289
4	Linda Gilbert and Jimmie Gilbert: Elements of Modern Algebra (8/e) Cengage Learning, Stamford(2015) ISBN: 1-285-46323-4
5	John R. Durbin : Modern Algebra: An Introduction(6/e) Wiley(2015) ISBN: 1118117611
6	Jeffrey Bergen: A Concrete Approach to Abstract Algebra- From the integers to Insolvability of Quintic Academic Pres [Elsever](2010)ISBN: 978-0- 12-374941-3

FIFTH SEMESTER

SJSDC5MT20 REAL ANALYSIS

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Understand Algebraic, Order and completeness properties of real line

CO2 Understand the concepts of Intervals, sequence and its limits, monotone sequences and learn the basic theorems related to it

CO3 Find convergence and divergence of sequence and learn theorems related to convergence

CO4 Understand the concept of Series and its convergence

CO5 Understand Basics of differentiation and Riemann Integration

Syllabus

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

Module-I Text (1) (15 hrs)

1.3: Finite and Infinite Sets-definition, countable sets, denumerability of $\mathbb{Q}$,, union of countable sets, cantor's theorem

2.1: The Algebraic and Order Properties of $\mathbb{R}$- algebraic properties, basic results, rational and irrational numbers, irrationality of $\sqrt{2}$, Order properties, arithmetic-geometric inequality, Bernoulli's Inequality

2.2: Absolute Value and the Real Line- definition, basic results, Triangle Inequality, The real line, ε-neighborhood

2.3: The Completeness Property of $\mathbb{R}$- Suprema and Infima, alternate formulations for the supremum, The Completeness Property

2.4: Applications of the Supremum Property- The Archimedean Property,

various consequences, Existence of $\sqrt{2}$, Density of Rational Numbers in $\mathbb{R}$, The Density Theorem, density of irrationals

Module-II Text (1)

2.5: Intervals-definition, Characterization of Intervals, Nested Intervals, Nested Intervals Property, The Uncountability of $\mathbb{R}$,

3.1: Sequences and Their Limits- definitions, convergent and divergent sequences, Tails of Sequences, Examples

3.2: Limit Theorems- sum, difference, product and quotients of sequences, Squeeze Theorem, ratio test for convergence

3.3: Monotone Sequences-definition, monotone convergence theorem

3.4: Subsequences and the Bolzano-Weierstrass Theorem- definition, limit of subsequences, divergence criteria using subsequence

Module-III Text (1)

3.5: The Cauchy Criterion- Cauchy sequence, Cauchy Convergence Criterion, applications

3.6: Properly divergent sequences-definition, examples

5.1: Continuous Functions- definition, sequential criteria for continuity, discontinuity criteria, examples of continuous and discontinuous functions

5.4 : Uniform Continuity- definition, illustration, Nonuniform Continuity Criteria, Uniform Continuity Theorem

3.7 Introduction to Infinite series (Exclude proof of theorems)

9.1 Absolute Convergence

9.2 Tests for Absolute Convergence

Module-IV Text (1)

6.1 The Derivative: Quick Review

6.2 The Mean Value Theorem: Interior Extremum Theorem, Rolle's Theorem, Mean Value Theorem

6.3 L'Hospital's Rules: Indeterminate Forms, Cauchy Mean Value Theorem, L'Hospital's Rule I (Exclude Proof), L'Hospital's Rule II (Exclude Proof)

6.4 Taylor's Theorem (statement only), Applications of Taylor's Theorem

7.1 Riemann Integral: Partitions and Tagged Partitions, Definition of the Riemann Integral, Some Exmaples

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	Terence Tao: Analysis I & II (3/e) TRIM 37 & 38 Springer Science+Business Media Singapore 2016; Hindustan book agency(2015) ISBN 978-981-10-1789-6 (eBook) & ISBN 978-981-10-1804-6 (eBook)
6	Ajith Kumar & S Kumaresan : A Basic Course in Real Analysis CRC Press, Taylor & Francis Group(2014) ISBN: 978-1-4822-1638-7 (eBook - PDF)
7	Hugo D Junghenn : A Course in Real Analysis CRC Press, Taylor & Francis Group(2015) ISBN: 978-1-4822-1928-9 (eBook - PDF)

FIFTH SEMESTER

SJSDC5MT21 COMPLEX ANALYSIS

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Understand the difference between differentiability and analyticity of a complex function, construct examples, Learn necessary and sufficient condition for checking analyticity.

CO2 Understand elementary analytic functions of complex analysis and their properties

CO3 Understand Complex integration and finding residue using integration

CO4 Understand more general type of series expansion analogous to power series expansion viz.Laurent's series expansion for functions having singularity.

Syllabus

Text: Complex Analysis A First Course with Applications (3/e): Dennis Zill & Patric Shanahan *Jones and Bartlett Learning(2015)ISBN:1- 4496-9461-6*

Module-I (15 hrs)

1.1 Complex Numbers and Their Properties
1.2 Complex Plane
1.3 Polar Form of Complex Numbers
1.4 Powers and Roots
2.1 Complex Functions
2.2 Complex Functions as Mappings
2.3 Linear Mappings
2.6 Limits and Continuity

Module-II (15 hrs)

3.1 Differentiability and Analyticity
3.2 Cauchy-Riemann Equations
3.3 Harmonic Functions

4.1 Exponential and Logarithmic Functions
4.2 Complex Powers
4.3 Trigonometric and Hyperbolic Functions
4.4 Inverse Trigonometric and Hyperbolic Functions

Module-III (15 hrs)

5.1 Real Integrals
5.2 Complex Integrals
5.4 Independence of Path
5.5 Cauchy's Integral Formulas and Their Consequences

Module-IV (15 hrs)

6.1 Sequences and Series
6.2 Taylor Series
6.3 Laurent Series
6.4 Zeros and Poles
6.5 Residues and Residue Theorem

References:

1	James Ward Brown, Ruel Vance Churchill: Complex variables and applications(8/e) McGraw-Hill Higher Education, (2009) ISBN: 0073051942
2	Alan Jeffrey: Complex Analysis and Applications(2/e) Chapman and Hall/CRC Taylor Francis Group(2006)ISBN:978-1-58488-553-5
3	Saminathan Ponnusamy, Herb Silverman: Complex Variables with Applications Birkhauser Boston(2006) ISBN:0-8176-4457-4
4	John H. Mathews & Russell W. Howell : Complex Analysis for Mathematics and Engineering (6 /e)
5	H A Priestly : Introduction to Complex Analysis(2/e) Oxford University Press(2003)ISBN: 0 19 852562 1
6	Jerrold E Marsden, Michael J Hoffman: Basic Complex Analysis(3/e) W.H Freeman,N.Y.(1999) ISBN:0-7167- 2877- X

ARTIFICIAL INTELLIGENCE

FIRST SEMESTER

SJSDC1AI03 – INTRODUCTION TO ARTIFICIAL INTELLIGENCE

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO 1. Compare AI with human intelligence and traditional information processing and discuss its strengths and limitations as well as its application to complex and human-centred problems.

CO 2. Understand the core concepts and algorithms of advanced AI, including informed searching, CSP, logic, uncertain knowledge and reasoning, dynamic Bayesian networks, graphical models, decision making, multi agent, inductive learning, statistical learning, reinforcement learning, deep learning, natural language processing, robotics, and so on.

CO 3. Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.

CO 4. Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

CO 5. Design AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.

Syllabus

Module-I (15 hrs)

What is Artificial Intelligence: The AI Problems, The Underlying assumption, What is an AI Technique?, The Level of the model, Criteria for success, some general references, One final word and beyond.

Problems, problem spaces, and search: Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional Problems.

Intelligent Agents: Agents and Environments, The nature of environments, The structure of agents.

Module-II (15 hrs)

Heuristic search techniques: Generate-and-test, Hill climbing, Best-first search, Problem reduction, Constraint satisfaction, Mean-ends analysis.

Knowledge representation issues: Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The frame problem.

Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution,

Natural Deduction. Logical Agents: Knowledge –based agents, the Wumpus world, Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic

Module-III (15 hrs)

Probabilistic reasoning: Bayes rule, Bayesian networks, hidden Markov model

Symbolic Reasoning Under Uncertainty: Introduction to non-monotonic reasoning, Logic for non-monotonic reasoning, Implementation Issues, Augmenting a problem-solver

Implementation: Depth-first search

Implementation: Breadth-first search.

Module-IV (15 hrs)

Weak Slot-and-filter structures: Semantic Nets, Frames.

Strong slot-and –filler structures: Conceptual dependency, scripts, CYC.

Adversarial Search: Games, Optimal Decision in Games,Min max algorithm ,Alpha-Beta Pruning, Summary

References:

1	"Artificial Intelligence" -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill
2	Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig, PHI
3	Introduction to Prolog Programming By Carl Townsend.
4	"PROLOG Programming For Artificial Intelligence" -By Ivan Bratko(Addison-Wesley)
5	A First Course in Artificial Intelligence, Deepak Khemani,TMH
6	. Artificial Intelligence & Soft Computing for Beginners, AnanditaDasBhattacharjee
7	"Understanding Machine Learning:From Theory To Algorithms,2017 By Shai Shalev-Shwartz And Shai Ben-David
8	Introduction To Machine Learning,An Early Draft Of A Proposed Textbook,Nils J. Nilsson Robotics Laboratory Department Of Computer Science Stanford University,Stanford, Ca 94305

FIRST SEMESTER

SJSDC1AI04 – PYTHON PROGRAMMING

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO 1. Familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc.
CO 2. Understand how to read/write to files, handle exception using python.
CO 3. Build package Python modules for reusability.
CO 4. Design and understand object-oriented concepts with Python classes.
CO 5. Understand the concept of pattern matching.
CO 6. Design GUI applications along with database connectivity to move the data to/from the application

Syllabus

Module-I (15hrs)

Introduction: The Python Programming Language, History, features, Installing Python, Running Python program

Debugging : Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging

Formal and Natural Languages, The Difference Between Brackets, Braces, and Parentheses

Variables and Expressions: Values and Types, Variables, Variable Names and Keywords, Type conversion, Operators and Operands, Expressions, Interactive Mode and Script Mode, Order of Operations.

Conditional Statements: if, if-else, nested if –else

Looping: for, while, nested loops

Control statements: Terminating loops, skipping specific conditions

Module-II (15 hrs)

Functions: Function Calls, Type Conversion Functions, Math Functions, Composition, Adding New Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters Are Local, Stack Diagrams, Fruitful Functions and Void Functions, Why Functions? Importing with from, Return Values, Incremental Development, Composition, Boolean Functions, More Recursion, Leap of Faith, Checking Types

Strings: A String Is a Sequence, Traversal with a for Loop, String Slices, Strings Are Immutable, Searching, Looping and Counting, String Methods, The in Operator, String Comparison, String Operations.

Module-III (15 hrs)

Lists: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List, Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods

Tuples and Dictionaries: Tuples, Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in Tuple Functions

Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods

Files: Text Files, The File Object Attributes, Directories

Exceptions: Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions

Module-IV (15 hrs)

Regular Expressions: Concept of regular expression, various types of regular expressions, using match function.

Classes and Objects: Overview of OOP (Object Oriented Programming), Class Definition, Creating Objects, Instances as Arguments, Instances as return values, Built-in Class Attributes, Inheritance, Method Overriding, Data Encapsulation, Data Hiding

Modules: Importing module, Creating and exploring modules, Math module, Random module, Time module

Programming in Python with sqlite3: Creating Tables, Querying (Inserting Tuples, Selecting Rows and Updating Tuples) Using Cursor to Iterate over Selected Tuples.

References:

1	Allen Downey. (2012). Think Python. Needham, Massachusetts: O'Reilly.
2	Allen Downey. (2012). Think Python.Retrieved from http://www.greenteapress.com/thinkpython/thinkpython.pdf
3	Goodrich, Tamassia, Goldwasser.(2016).Data Structures and Algorithms in Python: J. Wiley.
4	Wiley.Rance D. Necaise, College of William and Mary.(2016).Data Structures and Algorithms Using Python:
5	Introduction to Computing Using Python: An Application Development Focus, 2nd Edition, Ljubomir Perkovic, ISBN: 978-1-118-89094-3.

FIRST SEMESTER

SJSDC1AI05(P) - PYTHON PROGRAMMING (LAB)

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Prac

1.
   a. Write a function to check the input value is Armstrong and also write the function for Palindrome.
   b. Write a recursive function to print the factorial for a given number.
   c. Take a list, say for example this one:a = [1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89]and write a program that prints out all the elements of the list that are less than 5.
   d. Write a program that takestwo lists and returns True if they have at least one common member.
   e. Write a Python program to print a specified list after removing the 0th, 2nd, 4thand 5thelements.
   f. Define a procedure histogram () that takes a list of integers and prints a histogram to the screen.
2.
   a. Programs based on lists, conditional constructs, the for statement and the range function; interactively using the built-in functions len, sum, max, min.
   b. b. Programs using break and continue statements.
3.
   a. Programs related to string manipulation.
   b. Programs using list comprehensions and anonymous functions.
4.
   a. Programs related to dictionaries.
   b. Programs using the built-in methods of the string, list and dictionary classes
5.
   a. Design a class that store the information of Employee and display the same.
   b. Implement the concept of inheritance using python.
6.

a. Programs to read and write files.
b. Program to demonstrate exception handling

7. Program to demonstrate the use of regular expressions

8. Modules
   a. Write a program to implement userdefined module.
   a. Write a python program to demonstrate random module.
   b. Write a program to demostrate time module.

SECOND SEMESTER

SJSDC2AI07 –DATA STRUCTURES AND ALGORITHMS

3 hours/week3 Credits 75 Marks [Int:15+Ext:60]

Course Outcomes

CO 1. Survey algorithmic strategies give presentations using open source documentation tools like Latex and soft skill methodologies.
CO 2. Write mathematical modeling of algorithms for problem solving.
CO 3. Develop SRS in the UG projects;
CO 4. Solve problems for multi-core or distributed or concurrent/Parallel/Embedded environments;

Syllabus

Module-I (12 hrs)

Introduction, Data and Information, Data Structure, Classification of Data Structures, Primitive Data Types, Abstract Data Types, Operations on Data Structure

Algorithm, Importance of Algorithm Analysis, Complexity of an Algorithm, Asymptotic Analysis and Notations, Rate of Growth and Big O Notation

ArrayIntroduction, One Dimensional Array, Memory Representation of One Dimensional Array, Traversing, Insertion, Deletion, Searching, Merging of Arrays, Multidimensional Arrays, Memory Representation of Two Dimensional Arrays, General Multi-Dimensional Arrays, Sparse Arrays, Sparse Matrix, Memory Representation of Special kind of Matrices, Advantages and Limitations of Arrays.

Module-II (12 hrs)

Linked List, One-way Linked List, Traversal of Linked List, Searching, Memory Allocation and De-allocation, Insertion in Linked List, Deletion from Linked List, Reversing One way linked List,

Circular Linked List, Applications of Circular Linked List,

Two way Linked List, Traversing a Two way Linked List, Searching in a Two way linked List, Insertion of an element in Two way Linked List, Deleting a node from Two way Linked List,

Header Linked List, Applications of the Linked list,

Representation of Polynomials, Storage of Sparse Arrays, Application –Disk Management system.

Stack Introduction, Operations on the Stack Memory Representation of Stack, Array Representation of Stack, Applications of Stack,

Evaluation of Arithmetic Expression, Matching Parenthesis, infix and postfix operations, Recursion , Application –backtracking and 8 Queens Problem

Module-III (12 hrs)

Representation of Queue, Circular Queue, Some special kinds of queues, Deque, Priority Queue, Application of Priority Queue, Applications of Queues

Sorting and Searching Techniques Bubble, Selection, Insertion

Merge Sort Searching: Sequential, Binary, Indexed Sequential Searches Binary Search.

Binary Tree, Properties of Binary Tree, Memory Representation of Binary Tree, Operations Performed on Binary Tree, Reconstruction of Binary Tree from its Traversals,

Huffman Algorithm, Binary Search Tree, Operations on Binary Search Tree

Heap, Memory Representation of Heap, Operation on Heap, Heap Sort.

Application- min-max algorithm

Module-IV (12 hrs)

Advanced Tree Structures Red Black Tree, Operations Performed on Red Black Tree, AVL Tree, Operations performed on AVL Tree, 2-3 Tree, B-Tree

Hashing Techniques, Hash function, Address calculation techniques, Common hashing functions Collision resolution, Linear probing, Quadratic, Double hashing, Bucket hashing, Deletion and rehashing.

Graph: Introduction, Graph, Graph Terminology, Memory Representation of Graph, Adjacency Matrix Representation of Graph, Adjacency List or Linked Representation of Graph, Operations Performed on Graph, Graph Traversal-BFS,DFS, Applications of the Graph, Reachability, Shortest Path Problems, Spanning Trees.

References:

1	"Introduction to Algorithms", Thomas Coreman et al.
2	Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2ND Edition. University Press, ISBN: 978 81 7371 6126, 81 7371 61262.
3	Gilles Brassard and Paul Bartley, "Fundamental of Algorithmics", PHI, New Delhi
4	Algorithms, Kenneth Berman and Jerome Paul, Cenage Learning, ISBN-13 978-81-315-0521-2
5	Dinesh.P Mehta and Sartaj Sahni, Handbook of Data structures
6	Lalit Goyal, Vishal Goyal, Pawan Kumar(2014). A Simplified Approach to Data Structures. SPD
7	Sorting and Searching (DATA STRUCTURES AND ALGORITHMS) by Kurt Mehlhorn .

SECOND SEMESTER

SJSDC2AI09(P) - DATA STRUCTURES AND ALGORITHMS(LAB)

4 hours/week4Credits 100 Marks [Int:20+Ext:80]

Practical List

1. Implement the following for Linked List:
    a. Write a program to create a single linked list and display the node elements in reverse order.
    b. Write a program to search the elements in the linked list and display the same
    c. Write a program to create double linked list and sort the elements in the linked list.
2. Implement the following for Stack:
    a. Write a program to implement the concept of Stack with Push, Pop, Display and Exit operations using array & linked list.
    b. Write a program to convert an infix expression to postfix and prefix conversion
    c. Write a program to implement Tower of Hanoi problem.
3. Implement the following for Queue:
    a. Write a program to implement the concept of Queue with Insert, Delete, Display and Exit operations using array & linked list.
    b. Write a program to implement the concept of Circular Queue
    c. Write a program to implement the concept of Deque
4. Implement the following sorting techniques:
    a. Write a program to implement bubble sort.
    b. Write a program to implement selection sort.
    c. Write a program to implement insertion sort.

5. Implement the following data structure techniques:
    a. Write a program to implement merge sort.
    b. Write a program to search the element using sequential search.
    c. Write a program to search the element using binary search.
6. Implement the following data structure techniques:
    a. Write a program to construct the binary tree.
    b. Write a program to construct Binary Search Tree
    c. Write a program for in order, postorder and preorder traversal of Binary search tree
7. Implement the following data structure techniques
    a. Write a program to insert the element into maximum heap
    b. Write a program to insert the element into minimum heap.
8. Implement the following data structure techniques:
    a. Write a program to implement the collision technique
    b. Write a program to implement the concept of linear probing.
9. Implement the following data structure techniques:
    a. Write a program to generate the adjacency matrix
    b. Write a program for shortest path diagram

THIRD SEMESTER

SJSDC3AI14 INTRODUCTION TO MECHINE LEARNING

3 hours/week3 Credits 75 Marks [Int:15+Ext:60]

Course Outcomes

CO 1. Design a learning model appropriate to the application
CO 2. Design a Neural Network for an application of your choice.
CO 3. Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results
CO 4. Use a tool to implement typical Clustering algorithms for different types of applications.

Syllabus

Module-I (12 hrs)

Introduction: Concept of learning models, Supervised Learning, Unsupervised Learning, Linear Regression with One Variable -idea of cost function, and gradient descent method for learning, Linear Regression with Multiple Variables-Multiple Features, Gradient Descent for Multiple Variables, Feature Scaling, Learning Rate, Normal Equation, Non-invertibility, Polynomial Regression, Logistic Regression-classification, hypothesis representation, decision boundary, cost function, optimization, multiclass classification.

Module-II (12 hrs)

SVM: introduction, optimization objective, large margin classification, support vectors, Separating hyperplane approaches, support vector machine formulation, interpretation and analysis, SVMs for Linearly Non Separable Data, SVM Kernels, Hinge Loss formulation

Module-III (12 hrs)

Decision Tree: Introduction, Non-linearity, Selecting Regions, Defining Loss Function, Regression Trees, Stopping Criteria and Pruning, Loss Functions,

Categorical Attributes, Multiway Splits, Missing Values, Imputation, Surrogate Splits, Instability, Smoothness, Repeated Subtrees. Ensembling Methods-Bagging, Boosting

K-NN, Naive Bayes classifiers.

Module-IV (12 hrs)

Unsupervised Learning: Clustering: Introduction, k-means algorithm, optimization, random initialization, clustering. Hierarchical clustering .

Dimensionality Reduction: Data compression, visualization, principal component analysis algorithm, reconstruction from compressed representation, Independent Components Analysis. Latent space methods; PCA

References:

1	Tom Mitchell, "Machine Learning", McGraw-Hill 1997
2	Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elementsof Statistical Learning: Data Mining, Inference, and Prediction", Second Edition, Springer Series in Statistics, 2016
3	Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, MIT Press, 2010
4	Machine Learning with Python: Design and Develop Machine Learning and Deep Learning Technique using real world code examples, BPB Publications, 2018

THIRD SEMESTER

SJSDC3AI15(P) – MECHINE LEARNING (LAB)

3 hours/week3 Credits 75 Marks [Int:15+Ext:60]

Practical List

1. Perform the data classification using classification algorithm
2. Perform the data clustering using clustering algorithm.
3. Perform the Linear regression on the given data warehouse data.
4. Perform the logistic regression on the given data warehouse data.
5. Implement decision tree learning algorithm
6. Program to create sample data for testing
7. Regression :
    a. Perform training and testing of data
    b. Perform forecasting and predicting of data.
8. Support Vector Machine:
    a. Create SVM from scratch
    b. Program to perform SVM optimization using python.
9. Implement feed forward back propagation neural network learning algorithm
10. Implement Naive Bayes' learning algorithm .

THIRD SEMESTER

SJSDC1AI16(P) ARTIFICIAL INTELLIGENCE(LAB)

4 hours/week4Credits 100 Marks [Int:20+Ext:80]

Practical List

1. Write a program to implement depth first searchalgorithm.
2. Write a program to implement breadth first searchalgorithm.
3. Write a program to simulate 4-Queen / N-Queen problem.
4. Write a program to solve tower of Hanoi problem.
5. Write a program to implement alpha beta search.
6. Write a program for Hill climbing problem.
7. Write a program to implement A*algorithm
8. Design the simulation of tic–tac–toe game using min-max algorithm
9. Write a program to shuffle Deck of cards
10. Write a program to derive the predicate.
11. Solve constraint satisfaction problem9.(a) Derive the expressions based on Associative law(b)Derive the expressions based on Distributive law.
12. Develop a game using Pygame community.

FOURTH SEMESTER

SJSDC4AI19 ARTIFICIAL NEURAL NETWORK

3 hours/week3 Credits 75 Marks [Int:15+Ext:60]

Course Outcomes

CO 1. Mathematically model a neuron Understand
CO 2. Model a linear regressor/classifier using a perceptron model Apply
CO 3. Solve non-linear problems using multi-layer neural network Apply
CO 4. Implement better training algorithms for neural network

Syllabus

Module-I (12 hrs)

Introduction: Motivation from Human Brain, mathematical model of a neuron, basic computational unit, Activation Functions, Neural networks viewed as Directed Graphs, Feedback, Network Architectures, Knowledge Representation. Learning Process–Supervised, Unsupervised and Reinforcement learning, Learning Tasks-Pattern Association, recognition, function approximation, control, beamforming.

Module-II (12 hrs)

. Perceptron: Perceptron convergence theorem, Relation between perceptron and Bayes classifier for a Gaussian Environment, computer, batch perceptron algorithm. Model building through regression-linear regression model, Cost Function, gradient descent algorithm, chain rule, optimization, Local minima, Global Minima

Module-III (12 hrs)

Multilayer Perceptron: Batch learning and Online learning, Back propagation algorithm, XOR problem, heuristics for making the back-propagation algorithm perform better, activation functions, differentiability, symmetric, feature scaling, initialization, stopping criteria.

Module-IV (12 hrs)

Learning: back propagation and differentiation, Hessian matrix, optimal annealing and adaptive control of the learning rate, Approximations of function, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning.

References:

1	Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004..
2	Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
3	Francois Chollet, "Deep Learning with Python", Manning Publications, 2018
4	Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw- Hill Inc. 2000
5	Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
6	Simon Haykin, "Neural Networks and Learning Machines", Pearson Education India; Third edition 2016
7	Martin T Hagan, Howard B Demuth, Mark H Beale, Orlando De Jesús, "Neural Network Design", Cengage Learning,2nd Edition, 2014

FOURTH SEMESTER

SJSDC4AI21(P) - ARTIFICIAL NEURAL NETWORK (LAB)

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Practical List

1. To Write a program to implement Perceptron.
2. To write a program to implement AND OR gates using Perceptron.
3. Write a Program for pattern reorganization.
4. To write a program to implement Wine Classification using Back propagation.
5. To implement Crab Classification using pattern net
6. Write a program to implement classification of linearly separable Data with a perceptron
7. Write a program to implement classification of non linearly separable Data with a perceptron
8. To study Long Short Term Memory for Time Series Prediction
9. Write a program to implement basic matrix operations

FIFTH SEMESTER

SJSDC1AI23 DEEP LEARNING

3 hours/week3 Credits 75 Marks [Int:15+Ext:60]

Course Outcomes

CO 1. Understand the role of Deep learning in Machine Learning Applications
CO 2. Design and implement Deep Learning Applications.
CO 3. Critically Analyse Different Deep Learning Models in Image Related Projects
CO 4. Design and implement Convolutional Neural Networks.

SYLLABUS

Module-I (12hrs)

History of Deep Learning, Deep Learning Success Stories,

Convolutional Neural Networks- this in first module ,applications(keras,tensorflow)tf.keras

- Invariance, stability.
- Variability models (deformation model, stochastic model).
- Scattering networks
- Group Formalism
- Supervised Learning: classification.
- Properties of CNN representations: invertibility, stability, invariance.
- covariance/invariance: capsules and related models.
- Connections with other models: dictionary learning, LISTA.
- Other tasks: localization, regression.
- Embeddings (DrLim), inverse problems
- Extensions to non-euclidean domains
- Dynamical systems: RNNs.

Module-II (12hrs)

Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization, Learning Vectorial Representations Of

Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT

Module-III (12hrs)

Gated Recurrent Units (GRUs), Long Short Term Memory (LSTM) Cells, Solving the vanidhing gradient

problem with LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images, Hierarchical Attention, Directed Graphical Models, Markov Networks, Using joint distributions for classification and sampling, Latent Variables, Restricted Boltzmann Machines, Unsupervised Learning, Motivation for Sampling, Markov Chains, Gibbs Sampling for training RBMs, Contrastive Divergence for training RBMs, Variational autoencoders, Autoregressive Models: NADE, MADE, PixelRNN,

Module-IV (12hrs)

Generative Adversarial Networks (GANs) -Discriminative vs. Generative Modeling, Generative Adversarial Nets, Conditional GAN, Super-Resolution GAN, CycleGAN.

References:

1	Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004..
2	Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
3	Francois Chollet, "Deep Learning with Python", Manning Publications, 2018
4	Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-Hill Inc. 2000
5	Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

6	Huttunen H., "Deep Neural Networks: A Signal Processing Perspective". In: Bhattacharyya S., Deprettere E., Leupers R., Takala J. (eds) Handbook of Signal Processing Systems. Springer, Cham, 2019

FIFTH SEMESTER

SJSDC1AI24 IOT PROGRAMMING

3 hours/week3 Credits 75 Marks [Int:15+Ext:60]

Course Outcomes

CO 1.Enable learners to understand System On Chip Architectures.
CO 2.Introduction and preparing Raspberry Pi with hardware and installation.
CO 3.Learn physical interfaces and electronics of Raspberry Pi and program them using practical's
CO 4.Learn how to make consumer grade IoT safe and secure with proper use of protocols

SYLLABUS

Module-I (12hrs)

Introduction and system Architecture - What Is IoT?, IoT Impact, Convergence of IT and OT , IoT Challenges, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack, Sensors, Actuators, Sensor Networks, Communications Criteria,IoT Service as a Platform.

Module-II (12hrs)

Introduction to Raspberry Pi: Introduction to Raspberry Pi, Raspberry Pi Hardware, Preparing your raspberry Pi. Raspberry Pi Boot: Learn how this small SoC boots without BIOS. Configuring boot sequences and hardware.

Programming Raspberry Pi Raspberry Pi and Linux: About Raspbian, Linux Commands, Configuring Raspberry Pi with Linux Commands Programming interfaces: Introduction to Node.js, Python. Raspberry Pi Interfaces: UART, GPIO, I2C, SPI Useful Implementations: Cross Compilation, Pulse Width Modulation, SPI for Camera.

Module-III (12hrs)

IoT Data Link Layer and Network Layer Protocols: PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z- Wave, Bluetooth Low Energy, Zigbee Smart Energy DASH7 Network Layer:IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP Transport layer protocols : Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) Session layer: Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT Service layer protocols: Service Layer - oneM2M, ETSI M2M, OMA, BBFs

Prototyping Embedded Devices: Electronics, Sensors, Actuators, Scaling Up the Electronics, Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, developing on the Arduino, Some Notes on the Hardware, Openness, Raspberry Pi, Cases and Extension Boards, Developing on the Raspberry Pi, Some Notes on the Hardware, Openness.

Module-IV (12hrs)

Prototyping Embedded Devices: Electronics, Sensors, Actuators, Scaling Up the Electronics, Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, developing on the Arduino, Some Notes on the Hardware, Openness, Raspberry Pi, Cases and Extension Boards, Developing on the Raspberry Pi, Some Notes on the Hardware, Openness

References:

1	Designing the Internet of Things Adrian McEwen, Hakim Cassimally WILEY First 2014
2	Internet of Things – Architecture and Design Raj Kamal McGraw Hill First 2017
3	Learning Internet of Things, Peter Waher, PacktPublishing(2015)
4	Mastering the Raspberry Pi, Warren Gay,Apress(2014)

FIFTH SEMESTER

SJSDC1AI25(P) DEEP LEARNING (LAB)

4 hours/week 4 Credits 100 Marks [Int:20+Ext:80]

PRACTICAL LIST

1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras
8. Implement a Simple LSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN
11. Implement simple programs for data manipulation with Numpy and Pandas.

FIFTH SEMESTER

SJSDC1AI26(P) – IOT LAB

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

PRACTICAL LIST

1. Preparing Raspberry Pi: Hardware preparation andInstallation
2. Linux Commands: Exploring theRaspbian
3. GPIO: Light the LED withPython
4. Displaying different LED patterns with Raspberry Pi.
5. Displaying time over 4 digit 7 segment display using Raspberry Pi
6. SPI: Camera Connection and capturing Images using SPI
7. Interfacing Raspberry Pi with RFID.
8 .Node RED: Connect LED to Internet of Things
9. Visitor monitoring with Raspberry Pi and Pi Camera.
10 .Create a simple Web server using Raspberry Pi

ELECTIVE COURSES

FIFTH SEMESTER

SJSDC5E01 NATURAL LANGUAGE PROCESSING AND INTRODUCTION TO COMPUTER VISION

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO 1. Understand fundamental concepts of Natural Language Processing.
CO 2. Design algorithms for NLP tasks.
CO 3. Develop useful systems for language processing and related tasks involving text processing.
CO 4. Understand the basics of computer vision

Syllabus

Module-I (16 hrs)

Introduction to Natural Language Understanding-Levels of language analysis-Syntax, Semantics, Pragmatics.Linguistic Background-An Outline of English Syntax.Lexicons, POS Tagging, Word Senses.Grammars and Parsing-Features, Agreement and Augmented Grammars.

Module-II (16 hrs)

Grammars for Natural Language, Parsing methods and Efficient Parsing.Ambiguity Resolution-Statistical Methods. Probabilistic Context Free Grammar.

Semantics and LogicalForm: Linking Syntax and Semantics-Ambiguity Resolution-other Strategies for Semantic Interpretation-Scoping and the Interpretation of Noun Phrases.

Module-III (16 hrs)

Knowledge Representation and Reasoning-Local Discourse Context and Reference-Using World Knowledge-Discourse Structure-Defining a Conversational Agent.

Applications-Machine Translation, Information Retrieval and Extraction, Text Categorization and Summarization.

Module-IV (12 hrs)

INTRODUCTION TO COMPUTER VISION: Elements of image processing, Intensity transformation and spatial filtering, Histogram processing, Edge detection filters, Image segmentation, Image formation, Geometric primitives and transformations,2D transformations,3D transformations, 3D to 2D projections Photometric image formation, Lighting, Reflectance and shading, Optics

References:

1	D. Jurafsky and J. H. Martin, Speech and Language Processing, Prentice Hall India,2000
2	James Allen, Natural Language Understanding, 2e, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA
3	Richard Szeliski,"Computer Vision: Algorithms and Applications" , Springer, 1st Ed.,2010
4	Linda G. Shapiro,"Computer Vision", Prentice Hall, 1st Ed., 2001

FIFTH SEMESTER

SJSDC5E02 - BIG-DATA ANALYTICS

4 hours/week3 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO 1. Understand the fundamentals of various big data analytics techniques.
CO 2. Familiar about the tools and practices for working with big data, time series and text analytics.
CO 3. Analyze the HADOOP and Map Reduce , Spark technologies associated with big data analytics.
CO 4. Familiar about the different hadoop ecosystems.
CO 5. Ability to deploy a structured lifecycle approach to data analytics problems and apply appropriate analytic techniques and tools to analyzing big data.

Syllabus

Module-I (16hrs)

Introduction to Big Data: Big data characteristics - Volume, Veracity, Velocity, Variety.

Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data

Analyst Perspective on Data Repositories , State of the Practice in Analytics, BI Versus Data Science, Current Analytical Architecture, Drivers of Big Data, Key roles for new big data ecosystem, Examples .

Module-II (16hrs)

Data Analytics Lifecycle Overview- Phases: Discovery, data preparation Model planning, model building, communicate results, operationalize.

Case Study: Global Innovation Network and Analysis (GINA)

Advanced Analytics-technology and tools: MapReduce and Hadoop, Analytics for Unstructured Data, Hadoop basics, Hadoop stack, HDFS, Apache Hadoop.

Module-III (16hrs)

Introduction to MapReduce- MapReduce Framework , A MapReduce Example: Word-count, vector multiplication.

Big Data Analytics using Spark- Architecture of Spark, Spark SQL, Spark Streaming, Spark MLLib, Spark GraphX.

Module-IV (12hrs)

The Hadoop Ecosystem- Pig , Hive , HBase, Mahout , NoSQL.

References:

1	David Dietrich, Barry Heller, Biebie Yang, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services, John Wiley &Sons, Inc
2	Frank J Ohlhorst, Big Data Analytics: Turning Big Data into Big Money, Wiley and SAS Business Series, 2012.
3	Jiawei Han, Micheline Kamber Data Mining Concepts and Techniques, Second Edition, Elsevier, Reprinted 2008.
4	M Sudheep Elayidom, Datamining and Warehousing, 1st Edition, Cengage Learning India Pvt Ltd

5	Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill, 2011

FIFTH SEMESTER

SJSDC5E03 – GRAPH THEORY

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO 1. Understand basic graph theoric nortions
CO 2. Understand different types of graph and its properties
CO 3. Develop problem solving skill in graph related applications

Syllabus

Text	A First Look at Graph Theory: John Clark & Derek Allan Holton, *Allied Publishers, First Indian Reprint 1995*

Module-I (12hrs)

1.1 Definition of graphs

1.2 Graphs as models

1.3 More definitions

1.4 Vertex degrees

1.5 Sub graphs

1.6 Paths and cycles

Module-II (16 hrs)

1.7 Matrix representation of a graph *[Proofs of Theorem 1.5 and Theorem 1.6 are omitted]*

2.1 Definitions and simple properties

2.2 Bridges *[Proofs of Theorem 2.6 and Theorem 2.9 are omitted]*

2.3 Spanning trees

Module-III (16 hrs)

2.5 Shortest pat problems- Dijkstra's algorithm with illustration *[all other topics in the section are omitted]*

2.6 Cut vertex and connectivity *[Proofs of Theorem 2.21 is omitted]*

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

3.3 Hamiltonian graphs *[Proof of Theorem 3.6 is omitted]*

Module-IV (16 hrs)

5.1 Plane and planar graphs *[Proof of Theorem 5.1 is omitted]*

5.2 Euler's formula *[Proof of Theorem 5.3 is omitted]*

6.1 Vertex colouring *[Proofs of Theorem 6.4 and Theorem 6.5 are omitted]*

References:

1	R.J. Wilson: Introduction to Graph Theory, 4th ed., *LPE, Pearson Education*
2	J.A. Bondy& U.S.R. Murty : Graph Theory with Applications
3	J. Clark & D.A. Holton: A First Look at Graph Theory, *Allied Publishers*
4	N. Deo : Graph Theory with Application to Engineering and Computer Science, *PHI.*

FIFTH SEMESTER

SJSDC5E04 – LINEAR PROGRAMMING

4 hours/week4 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Solve linear programming problems geometrically

CO2 Understand the drawbacks of geometric methods

CO3 Solve LP problems more effectively using Simplex algorithm via. the use of condensed tableau of A.W. Tucker

CO4 Convert certain related problems, not directly solvable by simplex method, into a form that can be attacked by simplex method.

CO5 Understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization

CO6 Understand game theory

CO7 Solve transportation and assignment problems by algorithms that take advantage of the simpler nature of these problems

Syllabus

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

Module-I (20 hrs)

Chapter1 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

Chapter2 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-II (16 hrs)

Chapter3 Noncanonical Linear Programming Problems:- Unconstrained Variables, Equations of Constraint, Concluding Remarks

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, Duality in Noncanonical Tableaus, Concluding Remarks

Module-III (12 hrs)

Chapter 5 Matrix Games:- An Example; Two-Person Zero-Sum Matrix Games, Domination in a Matrix Game, Linear Programming Formulation of Matrix Games, The Von Neumann Minimax Theorem, The Example Revisited, Two More Examples, Concluding Remarks

Module-IV (12 hrs)

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

References:

1	RobertJ.Vanderbei:LinearProgramming: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

Model Question Papers

MODEL QUESTION PAPER

SJSDC1ST01 – DISCRIPTIVE STATISTICS AND INTRODUCTION TO R

Time : 2.5 Hours **Max. Marks : 80**

PART A

(Each questions carries 2 marks)

1 Calculate GM of 2,4,8.
2 The mean of a series is 10 and its coefficient of variation is 40 percent, find the SD of the series.
3 Define Histogram.
4 What is a frequency polygon?
5 Calculate HM of 2, 3, 4, 5, 7.
6 If the sum of squares of the difference between 10 ranks of two series is 33, find the rank correlation coefficient.
7 Write down normal equations used for fitting a curve $y = ax^2 + \frac{b}{x}$
8 What is correlation?
9 Write down the normal equations to fitting a parabola.
10 If $\mu_2 = 4.5, \mu_3 = 3.9, \mu_4 = 4.6. Find\ \beta_1\ and\ \beta_2$.
11 Define mean deviation.
12 What do you mean by curve fitting?
13 Write down the two regression equations.
14 Write the syntax of plot( ).
15 Explain dnorm( ) function.

(Ceiling 25 Marks)

PART B

(Each questions carries 5 marks)

16 What are ogives? How will you construct it?
17 Calculate quartiles for the following data

Classes:	30-35	35-40	40-45	45-50	50-55	55-60	60-65
Freq. :	10	16	18	27	18	8	3

18 Calculate the mode for the following data.

Class :	0-9	10-19	20-29	30-39	40-49	50-59
Freq. :	5	10	17	33	22	13

19 Distinguish between absolute and relative measure of dispersion.
20 Calculate standard deviation of 129, 131, 125, 130, 126, 122.
21 Distinguish between correlation and regression.
22 Explain data types in R.
23 Explain any five vector functions in R.

(Ceiling 35 Marks)

PART C

Answer any 2 questions. Each question carries 10 marks.

24 Calculate mean, median and mode from the following data.

Class:	0-10	10-20	20-30	30-40	40-50	50-60
Freq.:	5	15	40	32	20	8

25 Calculate quartile deviation for the following data. Also calculate quartile coefficient of dispersion.

Class:	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Freq.:	6	18	25	50	37	30	24	10

26 Calculate Pearson's coefficient of correlation from the following taking 100 and 50 as the assumed average of X and Y respectively.

X:	104	111	104	114	118	117	105	108	106	100	104	105
Y:	57	55	47	45	45	50	64	63	66	62	69	61

27 Fit a parabola to the following data:

X:	1	2	3	4	5	6	7	8	9
Y:	2	6	7	8	10	11	11	10	9

$(2 \times 10 = 20$ Marks)

MODEL QUESTION PAPER

SJSDC3MT10-DIFFERENTIAL EQUATION

Time: 2.5 Hours **Max. Marks : 80**

PART A

(*Each question carries **2** marks*)

1. Find the order of the differential equation $t^2\frac{d^2y}{dt^2}+t\frac{dy}{dt}+2y=sin\ sin\ t$. Also state whether the equation is linear or nonlinear
2. Find the solution of the equation $\frac{dy}{dt}=-y+5$
3. Verify that $y_1(t)=e^t\ and\ y_2(t)=cosh\ cosh\ t$ are solutions of the differential equation $y''-y=0$.
4. Define directional field
5. State existence and uniqueness theorem for first-order linear equations
6. Show that the equation $(3x^2-2xy+2)+(6y^2-x^2+3)y'=0$ is exact.
7. Find the solution of the differential equation $y''-y=0$.
8. Define ordinary point and singular point of a homogeneous equation
9. Show that the improper integral $\int_1^\infty \frac{dt}{t}$ diverges.
10. Find $L\{1\}$
11. Find the inverse Laplace transform of the function $F(s)=\frac{3}{s^2+4}$
12. State Convolution theorem
13. Find the convolution $f*1$ for $f(t)=cos\ cos\ t$
14. Determine whether the given function is periodic. If so, find its fundamental period: $sin\ sin\ 5x$
15. State Fourier convergence theorem

(Ceiling: 25 Marks)

PART B

(*Each question carries **5** marks*)

16. Solve the differential equation $(4+t^2)\frac{dy}{dt}+2ty=4t$
17. Solve the separable differential equation $\frac{dy}{dx}=\frac{4x-x^2}{4+y^3}$. Also find the solution passing through the point (0,1).
18. Solve the differential equation $(y\ cos\ cos\ x\ +2xe^y)+(sin\ sin\ x\ +x^2e^y-1)y'=0$
19. Find the solution of the initial value problem $y''+5y'+6y=0.\ y(0)=2,\ y'(0)=3.$
20. Find the general solution of $y''+9y=0.$
21. Sketch the graph of $y=h(t)$, where $h(t)=u_\pi(t)-u_{2\pi}(t),\ t\geq 0.$
22. Solve the boundary value problem $y''+2y=0,\ y(0)=1,\ y(\pi)=0.$
23. Draw the directional field for the differential equation $y'=y+2$ .Also find the equilibrium solution

(Ceiling: 35 Marks)

PART C

(*Each question carries **10** marks. Answer any **two** questions.*)

24. (a) Find the general solution of the differential equation $\frac{dy}{dt} - 2y = 4 - t$

    (b) Solve the initial value problem $ty' + 2y = 4t^2,\ y(1) = 2.$

25. Solve the initial value problem $y' = 2t(1 + y),\ y(0) = 0$ by the method of successive approximations.
26. State and prove Abel's theorem
27. Find the general solution of the differential equation $y'' + y' + 9.25y = 0$. Also find the solution that satisfies the initial conditions $y(0) = 2,\ y'(0) = 8.$

(2x10=20 Marks)

MODEL QUESTION PAPER

SJSDC1AI03-INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Time: 2.5 Hours Max. Marks:80

PART A

(Each question carries **2** marks.)

1. What are games?
2. Define monotonic production system.
3. Define agent program
4. Explain the PEAS representation of self-driving cars.
5. Draw the semantic representation from these sentences-Jerry is a cat. Jerry is a mammal. Jerry is owned by Priya. Jerry is brown colored. All mammals are animal.
6. Make a frame representation for a book.
7. Explain the properties of quantifiers.
8. What is monotonic reasoning?
9. What are the applications of expert system?
10. What are the deterministic and non-deterministic games?
11. What is a human agent?
12. What are frames?
13. What is inheritable knowledge?
14. What are semantic nets?
15. Define the alpha, beta parameters of alpha beta pruning algorithm.

(Ceiling 25 marks)

PART B

(Each question carries **5** marks.)

16. Explain heuristics.
17. Write down the truth table for conjunction , disjunction , implication and bicondition.
18. Explain BFS.
19. Explain Intelligent Agents with Example.
20. Explain Mini-max algorithm.
21. What are the search algorithm terminologies? Explain it's properties.
22. Explain DFS?
23. Explain the knowledge base of wumpus world?

(Ceiling 35 marks)

PART C

(Answer any **two** questions. Each question carries **10** marks.)

24. Write a short note on Inference rules along with truth tables.
25. Explain strong slot and filler structure. Make a short note on CD.
26. Make a short note on Propositional Logic.
27. Briefly explain the history of AI with its applications

(2×10=20 marks)