CURRICULA AND SYLLABI

FOR

B. VOC. MATHEMATICS & ARTIFICIAL INTELLIGENCE

Under Choice Based Credit & Semester System

2020 Admissions (Updated)

40

Minutes

Board of Studies in Mathematics/Statistics/AI
Date : 12-06-2023 at 10.00 am
(Online mode)

The meeting started at 10.00am with a welcome speech by Ms Sinda Joy followed by Agenda presentation.

The following are the suggestions from the BoS members:

1. Recommended to convert skill component papers in statistics as general component papers in B.Voc. Mathematics and AI 2020 admission syllabus and paper codes of general and skill component papers rearranged accordingly
2. Recommended to give split up of skill component credits in the consolidated mark list in 2014 and 2021 regulations

Ms. Sinda Joy delivered the vote of thanks and the meeting concluded at 10.45 am

Members present :

1] Chairperson - Ms. Sinda Joy
Assistant Professor & Head
Department of Mathematics
St. Joseph's College (Autonomous), Irinjalakuda

2] University Nominee - Dr. Anil Kumar V
Professor & Head
Department of Mathematics
University of Calicut

3] Subject Expert - Dr. Subramanian K.S. Moosath
Professor & Head, Dept of Mathematics
Indian Institute of Space Science & Technology
Thiruvananthapuram

4] Industrial Expert - Mr. Arun Aniruddhan V
Engineer E
Sree Chithira Thirunnal Institute of Medical Sciences
Thiruvananthapuram

Department Members:

5] Ms. Sherin Jose T, Assistant Professor
6] Ms. Dhanya V.S., Assistant Professor
7] Dr. Deeni C.J., Assistant Professor
8] Ms. Alphy Joseph, Assistant Professor
9] Ms. Baby A.K., Assistant Professor

I declare that the meeting was held in online mode and all the above listed BoS members were present.

ST. JOSEPH'S COLLEGE (AUTONOMOUS) PIN 680 121 IRINJALAKUDA

PRINCIPAL IN - CHARGE
ST. JOSEPH'S COLLEGE
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Details of Change in Course code

Semester	Course Name	Existing Code	Changed Code
First	Transactions Essential English Language Skills	SJGEC1EG01	No Change
	Common Course -7 Malayalam Bhashayum Sahithyavum-I	SJGEC1ML02	No Change
	Prose And One Act Plays	SJGEC1HD02	No Change
	Introductory Statistics	SJSDC1ST01	SJGEC1ST03
	Calculus Of Single Variable 1	SJSDC1MT02	SJSDC1MT01
	Introduction To Artificial Intelligence	SJSDC1AI03	SJSDC1AI02
	Python Programming With Data Structure	SJSDC1AI04	SJSDC1AI03
	Python Programming With Data Structure (Lab)	SJSDC1AI04(P)	SJSDC1AI03(P)
Second	Ways With Words	SJGEC2EG03	SJGEC2EG04
	Common Course-9 Malayalam Bhashayum Sahithyavum-II	SJGEC2ML04	SJGEC2ML05
	Poetry And Short Stories	SJGEC2HD04	SJGEC2HD05
	Probability Theory	SJSDC2ST05	SJGEC2ST06
	Calculus Of Single Variable 2	SJSDC2MT06	SJSDC2MT04
	Differential Equations	SJSDC2MT07	SJSDC2MT05
	Design And Analysis Of Algorithms	SJSDC2AI08	SJSDC2AI06
	Design And Analysis Of Algorithms (Lab)	SJSDC2AI08(P)	SJSDC2AI06(P)
Third	Writing For Academic & Professional Success	SJGEC3EG05	SJGEC3EG07
	Probability Distributions And Sampling Theory	SJSDC3ST09	SJGEC3ST08
	Calculus Of Multivariable	SJSDC3MT10	SJSDC3MT07
	Numerical Analysis	SJSDC3MT11	SJSDC3MT08
	Introduction To Machine Learning	SJSDC3AI12	SJSDC3AI09
	Advanced Python Programming	SJSDC3AI13	SJSDC3AI10
	Advanced Python Programming (Lab)	SJSDC3AI13(P)	SJSDC3AI10(P)
Fourth	Zeitgeist : Readings On Society And Cultures	SJGEC4EG06	SJGEC4EG10
	Statistical Inference And Quality Control	SJSDC4ST14	SJGEC4ST09
	Number Theory & Linear Algebra	SJSDC4MT15	SJSDC4MT11
	Linear Programming	SJSDC4MT16	SJSDC4MT12
	Deep Learning & Neural Network	SJSDC4AI17	SJSDC4AI13
	Deep Learning & Neural Network (Lab)	SJSDC4AI17(P)	SJSDC4AI13(P)
	Mini Project	SJSDC4AI18	SJSDC4AI14
Fifth	Theory Of Equations & Abstract Algebra	SJSDC5MT19	SJSDC5MT15
	Real Analysis	SJSDC5MT20	SJSDC5MT16
	Complex Analysis	SJSDC5MT21	SJSDC5MT17
	Reinforcement Learning	SJSDC5AI22	SJSDC5AI18
	Iot Programming	SJSDC5AI23	SJSDC5AI19
	Reinforcement Learning (Lab)	SJSDC5AI22(P)	SJSDC5AI18(P)
	Iot Programming (Lab)	SJSDC5AI23(P)	SJSDC5AI19(P)
Sixth	Internship And Project	SJSDC6AI24	SJSDC6AI20

CONTENT

AIMS AND OBJECTIVES

The B. Voc courses are 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 OUTCOME

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. Attained a secure foundation in Mathematics and Artificial Intelligence subjects to complement the core for their future courses.

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

PSO3. Familiarized with additional relevant mathematical & AI techniques

subjects to complement the core.

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

PSO5. Attained Vocational and profession skill in AI system design and IOT programming along with mathematical and statistical problemsolving skill.

GENERAL PROGRAMME STRUCTURE

The B. Voc Programme is designed to bridge the potential skill gap identified. The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

GENERAL EDUCATION COMPONENTS a The general education component provides emphasis to Communication skill,

Presentation skill, Health and Safety and other relevant subjects in the field.

b An option for additional language should be provided which enhances the employability outside the state.

c General Education Components should not exceed 40% of the curriculum

d All B.Voc Programme should follow the General education component pattern listed below (Common English Courses and Additional language courses of LRP programmes of CUCBCSSUG 2014)

SKILL DEVELOPMENT COMPONENTS

a) This component should match the skill gap identified.

b) At least 50% of Skill Development Component should be allotted to practical and can grow up to 60% based on the nature of the course. The practical component can be carried out in the college and/or the industry partner premises.

LEVELS OF AWARDS

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

Awards	Duration
Diploma	2 Semester
Advance Diploma	4 Semester
B. Voc Degree	6 Semester

1. Students are free to exit at any point in the duration of the programme.
2. Only those students who successfully complete the courses and clear the examination are eligible for the certificate.
3. Separate certificate will be awarded for each year for successful candidates.
4. 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.
5. B. Voc. degree will confer to those who successfully complete the diploma, higher diploma and internship.

ADMISSION CRITERIA

ELIGIBILITY

- The admission to B Voc. programme will be as per the rules and regulations of the University for UG admissions.
- Basic eligibility for B.Voc. is 10+2 and above in any stream (No age limit)
- The eligibility criteria for admission shall be as announced by the University from time to time.
- Separate rank lists shall be drawn up for reserved seats as per the existing rules.
- Grace Marks may be awarded to a student for meritorious achievements in

co-curricular activities such as Sports/Arts/ NSS/NCC/ Student Entrepreneurship.

- Preferred subjects and index mark calculations will be decided by the respective Board of Studies.

DIPLOMA HOLDERS

Diploma holders (after 10+2) in the parent courses, approved by the University, who satisfies eligibility criteria can be admitted to the higher diploma(3 rd semester) based on the availability of the seats and is under the sole discretion of the principal of the college/ B. Voc consortium.

RESERVATION/QUOTA

A maximum of 50 students can be admitted to one B. Voc. programme. The students can be admitted only to the first semester (except for diploma holders). No students are admitted directly to the Third and Fifth semester in any circumstance except for diploma holders. Diploma holders may be permitted to third semester directly as mentioned above.

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

FEES STRUCTURE

1. The course fee and examination fee for the first three years will be decided by the University. The details of the fee structure for various courses are attached in the annexure 2.
2. The college can collect Caution deposit, PTA fund, special fees, university fees, sports fee etc according to the norms provided by the university at the time of admission.
3. After third year, with the consent of university/UGC, the college can conduct the same programme in self-financing mode (provided UGC not granting further funds). The Course fee and examination fee (Regular/improvement/supplementary) structure in self-financing mode will be decided by the University.

REGISTRATION/RE-REGISTRATION

Every candidate should register for all subjects of the Semester-End examinations of each semester. A candidate who does not register will not be permitted to attend the Semester-End examinations; he/she shall not be permitted to attend the next semester. A candidate shall be eligible to register for any higher semester, if he/she has satisfactorily completed the course of study and registered for the examination. He/she should register for the semester at the start of the semester before the stipulated date. University will notify the starting and closing dates for each semester.

RE-JOINING THE PROGRAMME

1. Rejoining the course will be allowed to only for the candidate who has secured a minimum CGPA of 2.5.
2. The candidate should remit the fees prevailing that time.
3. B. Voc. governing council will take the decision regarding the rejoining.

COURSE CALENDAR

The B. Voc programme conducted by the affiliated institutions follows a separate calendar from the conversional degree/ PG programme. The programme is distributed over six semesters and each semester constitute 90 working days inclusive of examination.

Note: Within a week after the commencement of classes of each semester, Head of each Institution should forward the list of students, details of faculty members allotted from the college and from industry partners along with their qualification and year of experience, to the University. Also, Head of each Institution shall ensure the availability of sufficient number of faculty members having experience and qualifications in the institution.

ASSESSMENT OF STUDENTS

Assessment of students for each subject will be done by internal continuous assessment and Semester End examinations. This dual mode assessment will be applicable to both Theory and Practical courses except for internship and project. Total marks in theory course reflect 80 marks external and 20 marks internal assessments. The mark division for practical courses are 20 marks internal and 80 marks external. For internship and project, there is no internal assessment. (Except for Broadcasting and Journalism, annexure attached).

	Courses	Internal	External
1	Theory	20	80
2.	Practical	20	80
3.	Internship/Project	0	100

INTERNAL

Internal assessment shall be conducted throughout the semester. It shall be based on internal examinations, assignments (such as homework, problem solving, group discussions, quiz, literature survey, seminar, team project, software exercises, etc.) as decided by the faculty handling the course, and regularity in the class. Assignments of every semester shall preferably be submitted in Assignment Book, which is a bound book similar to laboratory record.The mark distribution to award internal continuous assessment marks for theory subject should be as follows:

Assessment	Mark
Test papers (minimum two, best two out of three is preferred)	10
Assignments (minimum two) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.	5
Regularity in the class	5

The mark distribution to award internal continuous assessment marks for practical subject should be as follows:

Assessment Type	Mark
Evaluation in the lab and Rough Record	10
End-semester Test	4
Viva	1
Regularity	5

Note:

1. No candidate will be permitted to attend the end-semester practical examination unless he/she produces certified record of the laboratory.
2. Full credit for regularity in the class can be given only if the candidate has secured minimum

90% attendance in the subject. Attendance evaluation for each course is as follows

Attendance	Marks
90% and Above	5
85 to 89.9%	4
80 to 84.9%	3
76 to 79.9%	2
75 to75.9 %	1

EXTERNAL

- Semester-End examinations for theory and practical courses will be conducted by the University. There shall be University examinations at the end of each semester for both theory and practical. Failed or improvement candidates will have to appear for the Semester-End examinations along with regular students.
- At the starting of each semester, Colleges should prepare question bank (containing maximum questions from each module of various types mentioned in section 13 pattern of question paper) for the external theory/practical examinations for all courses during that semester and will be sent to the university. University will prepare the question papers and answer keys for each course and will sent back to the college for conducting the examination.
- University will appoint a Chairman for each B.Voc Programme. Chairman will monitor the University Practical Examinations and Evaluation of Theory and Practical papers.
- For the evaluation of theory papers, Chairman should form a team consisting of a chief and required additional Examiners for each course.
- At the starting of each semester, Colleges should prepare a panel of External examiners for conducting Practical examinations. Chairman/University will appoint examiners from the panel proposed by colleges.

- Practical Examinations can be conducted and evaluated from the college or the industry partner premises. The team for conducting and evaluating practical exams should include an examiner appointed from the approved panel of faculties, and an internal examiner.
- Head of Institution/ Chief of Examination of the college should take necessary steps to prevent any malpractices in the Semester-End examinations. If any such instances are detected, they should be reported to the University without any delay.
- University will be issuing mark list, provisional/original certificates to the candidates.

INTERNSHIP AND PROJECT

Internship and the major 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. The Evaluation process follows 100% external assessment (Except for Broadcasting and Journalism).

1. There will be internship/project at the end of 2^{nd} and 4^{th} semesters and an internship for the whole sixth semester.
2. 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.
3. The student has to make regular discussions with the guide while choosing the subject/area and throughout the life time of the project.
4. At least three reviews should be conducted to evaluate the progress of work.
5. An evaluation team is constituted for conducting the evaluation. The team consist of external examiner, allotted by the university from the approved examination panel, representative from the industry and a faculty.

6. Students should submit a report of their work. A valid certificate from the organization should be produced as a proof that the work is carried out in the respective organization.

7. Students are required to demonstrate the working model of their work (if possible) to the panel of examiners. A viva will be conducted based on the report and students are supposed to clarify the queries regarding their work.

8. Mark distribution for internship assessment (Except for Broadcasting & Journalism).

Distribution	Marks
Content and relevance of Dissertation	60
Viva	20
Presentation	10

QUALIFYING EXAMINATION DETAILS

MINIMUM FOR PASS

The successful completion of all the courses prescribed for the diploma/degree programme with E grade (40 %) 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. Course (at the time of publication of results of last semester) except project/internship 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.

IMPROVEMENT/SUPPLEMENTARY

Candidates shall be allowed to improve the grade of any two theory courses in a semester. This can be done only in the immediate subsequent chance. If the candidate gets more than 10% mark variations in the improvement chance, marks scored in the improvement chance will be considered for grading of the course; otherwise marks scored in the first attempt will be retained. No candidate shall be permitted to improve the marks scored in practical examinations and internal continuous assessment.

ATTENDANCE

A candidate shall be permitted to appear for the Semester-End examinations only if he/she satisfies the following requirements:

(a) He/she must secure not less than 75% attendance in the total number of working hours in each semester.

(b) He/she must earn a progress certificate from the head of the institution stating that he/she has satisfactorily completed the course of study prescribed in the semester as required by these regulations.

(c) His/her conduct must be satisfactory

It shall be open to the Vice Chancellor to grant condonation of shortage of attendance on the recommendation of the head of the institution in accordance with the following norms.

- The shortage shall not be more than 10%
- Shortage up to 20% shall be condoned once during the entire course provided such shortage is caused by continuous absence on genuine medical grounds.
- Shortage shall not be condoned more than twice during the entire course.

Candidate who is not eligible for condonation of shortage of attendance shall repeat the semester as per university norms.

CREDIT SYSTEM

Each subject shall have a certain number of credits assigned to it depending upon the academic load and the nature and importance of the subject. The credit associated with each subject will be shown in the prescribed scheme and syllabi. Each course shall have an integer number of credits, which reflects its weightage.

a) One Credit would mean equivalent of 15 periods of 60 minutes each, for theory, workshops/IT and tutorials;

b) For internship/field work, the credit weightage for equivalent hours shall be 50% of that for lectures/workshops;

c) For self-learning, based on e-content or otherwise, the credit weightage for equivalent hours of study should be 50% or less of that for lectures/workshops

INDIRECT GRADING SYSTEM

- Indirect Grading System based on a 7 -point scale is used to evaluate the performance of students.
- Each course is evaluated by assigning marks with a letter grade (A+, A, B, C, D, E or F) to that course by the method of indirect grading.
- An aggregate of E grade with 40 % of marks (after external and internal put together) is required in each course for a pass and also for awarding a degree/diploma.
- Appearance for Internal Assessment and End Semester Evaluation are compulsory and no grade shall be awarded to a candidate if she/he is absent for Internal Assessment / End Semester Evaluation or both.
- For a pass in each course 40% marks or E grade is necessary.
- A student who fails to secure a minimum grade for a pass in a course is permitted to write the examination along with the next batch.
- After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student should pass all courses. However, a student is permitted to move to the next semester irrespective of SGPA obtained.
- SGPA of the student in that semester is calculated using the formula

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

- 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

$$\text{CGPA} = \frac{\text{Total credit points obtained in six semesters}}{\text{Total credits acquired (180)}}$$

- SGPA and CGPA shall be rounded off to two 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 (See Annexure 4)

Marks scored	Grade	Remarks
90 and Above	A+	Outstanding
80 to 89	A	Excellent
70 to 79	B	Very Good
60 to 69	C	Good
50 to 59	D	Satisfactory
40 to 49	E	Adequate
Below 40	F	Failure

GRADE CARDS

The University shall issue to the students grade/marks card (by online) on completion of each semester, which shall contain the following information:

- Name of University

- Title of B.Voc Programme
- Semester concerned
- Name and Register Number of student
- Code number, Title and Credits of each course opted in the semester
- Internal marks, External marks, total marks, Grade point (G) and Letter grade in each course in the semester
- The total credits, total credit points and SGPA in the semester (corrected to two decimal places)
- Percentage of total marks

The final Grade/mark Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. However, as already mentioned, for the computation of CGPA only the best performed courses with maximum grade points alone shall be taken subject to the minimum credits requirements (180) for passing a specific degree. The final grade card shall show the percentage of marks, CGPA (corrected to two decimal places) and the overall letter grade of a student for the entire programme. The final grade/mark card shall also include the grade points and letter grade of general course and skill developmental courses separately. This is to be done in a seven point indirect scale.

EXTRA CREDIT ACTIVITIES

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

GRACE MARKS

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

PATTERN OF QUESTION PAPERS

The question papers of Semester-End examinations of theory subjects shall be able to perform achievement testing of the students in an effective manner. The question paper shall be prepared

(a) Covering all sections of the course syllabus and total marks from each module should be approximately same.

(b) Unambiguous and free from any defects/errors

(c) Emphasizing knowledge testing, problem solving & quantitative methods

(d) Containing adequate data/other information on the problems assigned (e) having clear and complete instructions to the candidates.

Duration of Semester-End examinations will be 3 hours. The pattern of questions for theory subjects and for Practical shall be as follows:

Section	Total No of Questions	No. of Questions to be answered	Marks for each question	Total marks
A: Very Short/Objective answer questions	10	10	1	10
B: Short answer questions	12	8	2	16
C: Short Essays	9	6	4	24
D: Essays	4	2	15	30
Total				80

Marks Distribution	Total marks
Theory/ Algorithm/Flow diagram	20
Implementation	30
Result/Output	10

Record	10
Viva	10
Total	80

MONITORING CELLS/COMMITTEES

EXAMINATION MONITORING CELL

Head of the each institution should formulate an Examination Monitoring Cell at the institution for conducting and supervising all examinations including the internal examinations. The structure and their collective responsibilities will be as per the university norms.

GRIEVANCE CELL

Each college should setup a Grievance Cell with at least four faculty members to look into grievances of the students, if any.

ANTI-RAGGING CELL

Head of Institution shall take necessary steps to constitute anti-ragging committee and squad at the commencement of each academic year. The committee and the squad shall take effective steps as specified by the Honorable Supreme Court of India, to prevent ragging.

CLASS COMMITTEE

Head of institution shall take necessary steps to form a class committee for each class at the start of classes of each semester. This class committee shall be in existence for the semester concerned. The class committee shall consist of the Head of Department, Staff Advisor of the class, a senior faculty member of the department, a faculty member from another department, and three student representatives (one of them should be a girl).

There should be at least two meetings of the class committee every semester; it shall be the responsibility of the Head of Department to convene these meetings. The decisions of the Class Committee shall be recorded in a register for further reference. Each class committee will communicate its recommendations to the Head of Institution.

The responsibilities of the class committee are:

a) To review periodically the progress and conduct of students in the class.

b) To discuss any problems concerning any courses in the semester concerned. c) To identify weaker students of the class and suggest remedial measures.

d) To review teaching effectiveness and coverage of syllabus.

e) Discuss any other issue related to the students of the class.

COLLEGE TRANSFER

College transfer is not allowed in any circumstances.

B.Voc degree is equal to any degree approved by University of Calicut

TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice-Chancellor has the power to provide by order that these regulations shall be applied to any program with such necessary modification.

SCHEME

Semester I									
C.No	Course Code	Course Name	Credit	Marks			Hours/week		
				Int	Ext	total	Th	Prac	Total
1.1	SJGEC1EG01	Transactions Essential English Language Skills (A01)	4	20	80	100	4		4
1.2	SJGEC1ML02	Common course -7 Malayalam Bhashayum Sahithyavum-I (A01 (2))	4	20	80	100	4		4
	SJGEC1HD02	Prose and one act plays (A07(3))							
1.3	SJGEC1ST03	Introductory Statistics (STA1C01)	5	20	80	100	4		4
1.4	SJSDC1MT01	Calculus of Single variable 1 (MTS2B02)	6	20	80	100	5		5
1.5	SJSDC1AI02	Introduction to Artificial Intelligence	5	20	80	100	5		5
1.6	SJSDC1AI03	Python Programming with Data Structure	3	20	80	100	4		4
1.7	SJSDC1AI03(P)	Python Programming with Data Structure (Lab)	3	20	80	100		4	4
		Semester I total	30			700	26	4	30

Semester II									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
2.1	SJGEC2EG04	Ways with Words (A02)	4	20	80	100	4		4
2.2	SJGEC2ML05	Common course-9 Malayalam Bhashayum Sahithyavum-II (A02(2))	4	20	80	100	4		4
	SJGEC2HD05	Poetry and short stories (A09(3))							
2.3	SJGEC2ST06	Probability Theory (STA2C02)	5	20	80	100	4		4
2.4	SJSDC2MT04	Calculus of Single Variable 2 (MTS3B03)	5	20	80	100	5		5
2.5	SJSDC2MT05	Differential Equations (MTS5B05)	6	20	80	100	5		5
2.6	SJSDC2AI06	Design and Analysis of Algorithms	3	20	80	100	4		4
2.7	SJSDC2AI06(P)	Design and Analysis of Algorithms (Lab)	3	20	80	100		4	4
		Semester II total	30			700	26	4	30
Semester III									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
3.1	SJGEC3EG07	Writing for academic & professional success (A03)	4	20	80	100	4		4
3.2	SJGEC3ST08	Probability Distributions and sampling theory (STA3C03)	5	20	80	100	5		5
3.3	SJSDC3MT07	Calculus of Multivariable (MTS6B12)	5	20	80	100	5		5
3.4	SJSDC3MT08	Numerical Analysis (MTS5B07)	5	20	80	100	4		4
3.5	SJSDC3AI09	Introduction to Machine Learning	5	20	80	100	4		4
3.6	SJSDC3AI10	Advanced Python Programming	3	20	80	100	4		4
3.7	SJSDC3AI10(P)	Advanced Python Programming (Lab)	3	20	80	100		4	4
		Semester III Total	30			700	26	4	30

Semester IV									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
4.1	SJGEC4EG10	Zeitgeist : Readings on society and cultures (A04)	4	20	80	100	4		4
4.2	SJGEC4ST09	Statistical Inference and Quality control (STA4C04)	5	20	80	100	5		5
4.3	SJSDC4MT11	Number Theory & Linear Algebra (MAT6B12)	6	20	80	100	5		5

4.4	SJSDC4MT12	Linear Programming (MTS5B08)	5	20	80	100	4		4
4.5	SJSDC4AI13	Deep learning & Neural Network	3	20	80	100	4		4
4.6	SJSDC4AI13(P)	Deep learning & Neural Network (Lab)	3	20	80	100		4	4
4.7	SJSDC4AI14	MINI PROJECT	4	20	80	100		4	4
		Semester IV total	30			700	22	8	30
Semester V									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
5.1	SJSDC5MT15	Theory of equations & Abstract Algebra (MTS5B05)	6	20	80	100	5		5
5.2	SJSDC5MT16	Real Analysis	6	20	80	100	5		5
5.3	SJSDC5MT17	Complex Analysis	6	20	80	100	5		5
5.4	SJSDC5AI18	Reinforcement learning	3	20	80	100	4		4
5.5	SJSDC5AI19	IOT Programming	3	20	80	100	4		4
5.6	SJSDC5AI18(P)	Reinforcement learning (Lab)	3	20	80	100		3	3
5.7	SJSDC5AI19(P)	IOT Programming (Lab)	3	20	80	100		4	4
		Semester V total	30			700	23	7	30
Semester VI									
C.No	Course Code	Course Name	Credit	Marks			Hrs/week		
				Int	Ext	total	Th	Prac	Total
6.1	SJSDC6AI20	INTERNSHIP AND PROJECT (900hrs)	30	0	100	100	0	30	30
		Semester VI total	30			100		30	30
		Grand Total	180			3600			

Component			Component wise credit	Total Credit
General Component	English	16	44	180
	Language	8		
	Statistics	20		
Skill Component	Mathematics	56	136	
	Artificial Intelligence	46		
	Mini Project/ Project/Internship	34		

GENERAL COMPONENT

ENGLISH

C.No	Course Code	Course Name	Credit	Marks			Hours/ week
				Int	Ext	total	
1.1	SJGEC1EG01	Transactions: Essential English Language Skills (A01)	4	20	80	100	4
2.1	SJGEC2EG04	Ways with the Words: Literatures in English (A02)	4	20	80	100	4
3.1	SJGEC3EG07	Writing for Academic and Professional Success (A03)	4	20	80	100	4
4.1	SJGEC4EG010	Zeitgeist - Readings on Contemporary Culture (A04)	4	20	80	100	4

MALAYALAM

C.No	Course Code	Course Name	Credit	Marks			Hours/ week
				Int	Ext	total	
1.2	SJGEC1ML02	Common course -7 Malayalam Bhashayum Sahithyavum-I (A01 (2))	4	20	80	100	4
2.2	SJGEC2ML05	Common course-9 Malayalam Bhashayum Sahithyavum-II (A02(2))	4	20	80	100	4

HINDI

C.No	Course Code	Course Name	Credit	Marks			Hours/ week
				Int	Ext	total	
1.2	SJGEC1HD02	Prose and one act plays (A07(3))	4	20	80	100	4
2.2	SJGEC2HD05	Poetry and short stories (A09(3))	4	20	80		4

STATISTICS

C.No	Course Code	Course Name	Credit	Marks			Hours/ week
				Int	Ext	total	
1.1	SJGEC1EG01	Introductory Statistics	4	20	80	100	4
2.1	SJGEC2EG04	Probability Theory	4	20	80	100	4
3.1	SJGEC3EG07	Probability Distributions and sampling theory	4	20	80	100	4
4.1	SJGEC4EG10	Statistical Inference and Quality control	4	20	80	100	4

* Syllabus of general component is subject to changes in the St. Joseph's college (Autonomous) Syllabus for the academic year 2020

STATISTICS

SEMESTER I

SJGEC1ST03- INTRODUCTORY STATISTICS

4 hours/week	5 Credits	100 Marks [Int:20+Ext:80]

1. To understand the statistical system and government organisations in India.
2. To 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.
5. To introduce the concepts of time series and index numbers.

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

Syllabus

Module 1: 7 hours

Official statistics: The Statistical system in India: The Central and State Government organizations, functions of the Central Statistical Office (CSO), National Sample Survey Organization (NSSO) and the Department of Economics and Statistics.

Module 2: 30 hours

Introduction to Statistics: Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics. Concept of primary and secondary data. Designing a questionnaire and a schedule. Concepts of statistical population and sample from a population, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data. Presentation of data by table and by diagrams, frequency distributions by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogives. Measures of central tendency (mean, median, mode, geometric mean and harmonic mean) with simple applications. Absolute and relative measures of dispersion (range, quartile deviation, mean deviation and standard deviation) with simple applications. Co-efficient of variation, Box

Plot. Importance of moments, central and non-central moments, and their interrelationships. Measures of skewness based on quartiles and moments; kurtosis based on moments.

Module 3: 15 hours

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

Module 4: 20 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.

Index numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's.

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.

SEMESTER II

SJGEC2ST06- PROBABILITY THEORY

4 hours/week	5 Credits	100 Marks [Int:20+Ext:80]

Course Outcome

1. To summarize various approaches to probability and compute probabilities.
2. To understand the concept of random variable and distribution function.
3. To verify the reproductive property of distributions using generating functions.
4. To understand the bivariate data and independence of random variables.
5. To derive various descriptive statistics using bivariate data.

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

Syllabus

Module 1: 25 hour

Introduction to Probability: Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, 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: 12 hours

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)

Module 3: 15 hours

Mathematical expectations (univaraite): Definition, raw and central moments(definition and relationships), moment generation function and properties, characteristic function (definition and use only), Skewness and kurtosis using moments

Module 4: 20 hours

Bivariate random variables: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

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	Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.
4	John E Freund, Mathematical Statistics, Pearson Edn, New Delhi

SEMESTER III

SJGEC3ST08- PROBABILITY DISTRIBUTIONS AND SAMPLING THEORY

5 hours/week	5 Credits	100 Marks [Int:20+Ext:80]

Course Outcome

1. To get a general understanding on various probability distributions.
2. To understand the application of theoretical distributions.
3. To equip students with sampling techniques used in conducting sample surveys.
4. To understand various sampling distributions and the related concepts.
5. To understand the interrelationships between the sampling distributions.

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

Syllabus

Module 1: 30 hours

Standard distributions: Discrete type-Bernoulli, Binomial, Poisson, Geometric, Negative Binomial (definition only), Uniform (mean, variance and mgf).

Continuous type-Uniform, exponential and Normal (definition, properties and applications); Gamma (mean, variance, mgf); Lognormal, Beta, Pareto and Cauchy (Definition only)

Module 2: 25 hours

Limit theorems: Chebyshev's inequality, Sequence of random variables, parameter and Statistic, Sample mean and variance, Convergence in probability (definition and example only), weak law of large numbers (iid case), Bernoulli law of large numbers, Convergence indistribution (definition and examples only), Central limit theorem (Lindberg levy-iid case)

Module 3: 10 hours

Sampling methods: Simple random sampling with and without replacement, systematic sampling (Concept only), stratified sampling (Concept only), Cluster sampling(Concept only)

Module 4: 25 hours

Definition of sampling distribution, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chi-square distribution, t- distribution, and F distribution (definition, derivations and relationships only).

eferences:

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.

SEMESTER IV

SJGEC4ST09 -- STATISTICAL INFERENCE AND QUALITY CONTROL

5 hours/week	5 Credits	100 Marks [Int:20+Ext:80]

Course Outcome

1. Understanding sampling distribution and study the criteria of good estimators and interval estimation.
2. To introduce the concepts of hypothesis testing.
3. Identify a suitable test of significance to test a given hypothesis - large sample test/small sample test for testing different parameters.
4. To provide basic principles of experimentation.
5. To provide an insight into quality assessment techniques.

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

Syllabus

Module 1: 30 hours

Estimation theory: Parametric space, sample space, point estimation. Nayman Factorization criteria, Requirements of good estimator: Unbiasedness, Consistency, Efficiency, Sufficiency and completeness. Minimum variance unbiased (MVU) estimators. Cramer-Rao inequality (definition only). Minimum Variance Bound (MVB) estimators.

Methods of estimation: Maximum likelihood estimation and Moment estimation methods (Detailed discussion with problems); Properties of maximum likelihood estimators (without proof); Least squares and minimum variance (concepts only).

Interval estimation: Confidence interval (CI);CI for mean and variance of Normal distribution; Confidence interval for binomial proportion and population correlation coefficient when population is normal.

Module 2: 35 hours

Testing of Hypothesis: Level of significance, Null and Alternative hypotheses, simple and composite hypothesis ,Types of Errors, Critical Region, Level of Significance, Power and p-values. Most powerful tests, Neyman-Pearson Lemma (without proof), Uniformly Most powerful tests. Large sample tests: Test for single mean, equality of two means, Test for single proportion, equality of two proportions. Small sample tests: ttest for single mean, unpaired and paired t-test.

Chi-square test for equality of variances, goodness of fit, test of independence and association of attributes. Testing means of several populations: One Way ANOVA, Two Way ANOVA

(assumptions, hypothesis, ANOVA table and problems)

Module 3: 10 hours

Non-parametric methods: Advantages and drawbacks; Test for randomness, Median test, Sign test, MannWhiteny U test and Wilcoxon test; Kruskal Wallis test (Concept only)

Module 4: 15 hours

Quality Control: General theory of control charts, causes of variations in quality, control limits, sub-grouping, summary of out-of-control criteria. Charts of variables - X bar chart, R Chart and sigma chart. Charts of attributes – c-charts, p-chart and np-chart.(Concepts and problems), process control and product control

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	Grant E L, Statistical quality control, McGraw Hill
5	Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

SKILL COMPONENT

MATHEMATICS

FIRST SEMESTER

SJSDC1MT01 CALCULUS OF SINGLE VARIABLE -1

5 hours/week 6 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

Syllabus

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

Module-I (20hrs)

(Functions and Limits)

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 (25 hrs)

(Applications of the Derivative)

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 (25 hrs)

(Integration)

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 (20 hrs)

(Applications of Definite Integral)

5.1 : 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?

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

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

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- 1-28574062-1
6	Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY (1985) 0-387-90974-5 : ISBN 0-387-90975-3

SECOND SEMESTER

SJSDC2MT04 CALCULUS OF SINGLE VARIABLE 2

5 hours/week 5 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

Syllabus

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

Module-I (25 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 (20 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 (20 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

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 (25 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: 978-1285-74062-1
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

SJSDC2MT05 DIFFERENTIAL EQUATIONS

5 hours/week 6 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 DEs 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 (25 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 (25 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

5.2: Series solution near an ordinary point, part1

5.3: Series solution near an ordinary point,part2

Module-III (20 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 (20 hrs)

10.1: Two-Point Boundary Value Problems

10.2: Fourier Series

10.3: The Fourier Convergence Theorem

0.4: Even and Odd Functions

10.5: Separation of Variables; Heat Conduction in a Rod 10.7:

The Wave Equation: Vibrations of an Elastic String

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
6	James C Robinson: An Introduction to Ordinary Differential Equations Cambridge University Press (2004)ISBN: 0-521-53391-0

THIRD SEMESTER

SJSDC3MT07 CALCULUS OF MULTIVARIABLE

5 hours/week 5 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

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.

Syllabus

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

Module-I (20 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 (20hrs)

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 (25hrs)

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
(25 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

SJSDC3MT08 NUMERICAL ANALYSIS

4 hours/week 5 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 (24 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

2.4 : Error Analysis for Iterative Methods- Order of Convergence, linear and quadratic convergence, Multiple Roots, Modified Newton's method for faster convergence

[Algorithms are omitted]

Interpolation and Polynomial Approximation

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.

[Algorithms are omitted]

Module-II (24 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

4.7:Gaussian Quadrature-motivation, Legendre Polynomial, Gaussian Quadrature on Arbitrary Intervals

[Algorithms are omitted]

Module-III (24 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]

5.6 : Multistep Methods- basic idea, definition, Adams-Bashforth Two-Step Explicit Method, Adams-Bashforth Three-Step Explicit Method, Adams- Bashforth Four-Step Explicit Method, Adams-Moulton Two-Step Implicit Method, Adams-Moulton ThreeStep Implicit Method, Adams-Moulton
Four-Step Implicit Method, Predictor-Corrector Methods [derivation of formula omitted in each case] [Algorithms are omitted]

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: 97881-265-0802-0]
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

FOURTH SEMESTER

SJSDC4MT11 NUMBER THEORY AND LINEAR ALGEBRA

5 hours/week 6 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 Solve linear congruent equations and applied theorems

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

CO6 Understand row space , column space, null space and find rank, nullity

CO7 Understand matrix transformation and its properties

Syllabus

Text	1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH. 2.T. S. Blynth and E.F. Robertson: Basic Linear Algebra, second Edn

Module-I (25 hrs)

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.

3.1 The fundamental theorem of arithmetic.

3.2 The sieve of Eratosthenes.

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. Fermat's little theorem

Module-II (20 hrs)

5.2 Pseudoprimes

5.3 Wilson's theorem.

6.1 The sum and number of divisors.

6.3 The greatest integer function.

7.2 Euler's phi-function.

7.3 Euler's generalization of Fermat's theorem.

7.4 Properties of the phi-function (Theorems 7.6 and 7.7 only).

Module-III (25 hrs)

Vectorspaces-examples,linearcombinations,spanning,linearindependence,base,finite dimensional vector spaces (All Sections in chapter 5 of text 2)

Module-IV (20 hrs)

Linear mappings- Linear transformations,examples,nullspace,rank –nullity theorem,linear isomorphism. (All Sections in chapter 6 of text 2)

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

SJSDC4MT12 LINEAR PROGRAMMING

4 hours/week 5 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 Undergraduate Texts in Mathematics Springer (1989) ISBN: 978-1-4612-6982-3

Module-I (24 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 (24hrs)

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 (24 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

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
5	Jiri Matoušek, Bernd Gartner: Understanding and Using Linear Programming Universitext, Springer-Verlag Berlin Heidelberg (2007)ISBN: 978-3-540-30697-9

FIFTH SEMESTER

SJSDC5MT15 THEORY OF EQUATIONS AND ABSTRACT ALGEBRA

5 hours/week 6 Credits 100 Marks [Int:20+Ext:80]

Course Outcomes

CO1 Learn different methods for finding roots of algebraic equations

CO2 Understand concepts of modulo n , equivalence, permutations, groups, subgroups and solve problems related to it

CO3 Understand cyclic groups, permutation groups, cosets, commutative rings, Integral domains and learn basic theorems related to the concepts

CO4 Understand the concept of Isomorphims, homomorphism and learn basic theorems related to the concepts

Syllabus

Text (1)	Theory of Equations : J V Uspensky McGraw Hill Book Company, Inc. (1948) ISBN:07-066735-7
Text:(2)	Abstract Algebra(3/e):John A Beachy and William D Blair Waveland Press, Inc.(2006) ISBN: 1-57766-443-4

Module-I Text (1) (25 hrs)

Theory of Equations

Chapter II

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

II.4 : The remainder theorem

II.5: Synthetic Division
II. 7: Taylor formula, expansion of a polynomial in powers of $x - c$

Chapter III
III.1: Algebraic equations, roots, maximum number of roots
III.2: Identity theorem
III.3:The Fundamental theorem of Algebra (statement only), factorisation to linear factors, multiplicity of roots
III.4: Imaginary roots of equations with real coefficients III.5:
Relations between roots and coefficients
Chapter IV
IV. 1: Limits of roots
IV.2: Method to find upper limit of positive roots
IV.3: Limit for moduli of roots [only the method to find out upper limit from the auxiliary equation is required; derivation omitted]
IV. 4: Integral roots IV.5: Rational roots
Chapter V
V. 1: What is the solution of an equation, algebraic solution or solution by radical
V.2: Carden's formula
V.3: Discussion of solution

V.4: Irreducible case
V. 6: Solutions of biquadratic equations, Ferrari method [example2 omitted] Chapter VI
VI. 1: Object of the Chapter
VI.2: The sign of a polynomial for small and large values of variables- locating roots of polynomial between two numbers having values of opposite sign- geometric illustration only-[rigorous reasoning in the starred section omitted]
VI.4: Corollaries- roots of odd and even degree polynomial, number of roots in an interval counted according to their multiplicity
VI.5: Examples
VI.6: An important identity and lemma [derivation not needed]
VI.7: Rolle's theorem [proof omitted], use in separating roots
VI.10: Descarte's rule of signs-only statement and illustrations are required
Chapter XI
XI.1: Symmetric Functions –definition, sigma functions, elementary symmetric functions

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

Module-II Text (2) (20 hrs)

Abstract Algebra

1.4:Integers modulo n- congruence class modulo n , addition and multiplication, divisor of zero, multiplicative inverse

2.2 : Equivalence relations-basic idea, definition, equivalence class, factor set, partition and equivalence relation, examples and illustrations

2.3 : Permutations- definition, cycles, product of cycles, permutation as product of disjoint cycles, order of cycles, transposition, even and odd transpositions

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

Module-III Text (2) (25 hrs)

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

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

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

Module-IV Text (2) (20hrs)

3.8 : Cosets- left and right cosets, normal subgroups and factor groups, fundamental homomorphism theorem, simple groups, examples and illustrations of concepts 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	Dickson L.E: Elementary Theory of Equations John Wiley and Sons,Inc. NY(1914)
2	Turnbull H.W: Theory of Equations(4/e) Oliver and Boyd Ltd. Edinburg(1947)
3	Todhunter I: An Elementary Treatise on the Theory of Equations(3/e) Macmillan and Co. London(1875)
4	William Snow Burnside and Arthur William Panton: The Theory of Equations with An Introduction to Binary Algebraic Forms Dublin University Press Series(1881)
5	Joseph A. Gallian : Contemporary Abstract Algebra(9/e) Cengage Learning, Boston(2017) ISBN: 978-1-305-65796-0
6	John B Fraleigh : A First Course in Abstract Algebra(7/e) Pearson Education LPE(2003) ISBN 978-81-7758-900-9
7	David Steven Dummit, Richard M. Foote: Abstract Algebra(3/e) Wiley, (2004) ISBN: 8126532289
8	Linda Gilbert and Jimmie Gilbert: Elements of Modern Algebra (8/e) Cengage Learning, Stamford(2015) ISBN: 1-285-46323-4
9	John R. Durbin : Modern Algebra: An Introduction(6/e) Wiley(2015) ISBN: 1118117611
10	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

SJSDC5MT16 REAL ANALYSIS

5 hours/week 6 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 complex plane, complex functions, polar form of complex numbers

CO5 Understand linear mappings, power functions, limit, continuity

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) (25hrs)

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, arithmeticgeometric 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 $\sqrt{2}$, ~~D~~ensity of Rational Numbers in $\mathbb{R}$, The Density Theorem, density of irrationals

Module-II Text (1) (25 hrs)

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, divergence of harmonic series, calculation of square root, Euler's number

3.4 : Subsequences and the Bolzano-Weierstrass Theorem- definition, limit of subsequences, divergence criteria using subsequence, The Existence of Monotone Subsequences, monotone subsequence theorem, The Bolzano-Weierstrass Theorem, Limit Superior and Limit Inferior

Module-III Text (1) (20 hrs)

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

3.6 : Properly divergent sequences-definition, examples, properly divergent monotone sequences, "comparison theorem" , "limit comparison theorem"

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

5.3 : Continuous Functions on Intervals- Boundedness Theorem, The MaximumMinimum Theorem, Location of Roots Theorem, Bolzano's Intermediate Value Theorem, Preservation of Intervals Theorem

Module-IV Text (2) (20 hrs)

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

Uniform Continuity Theorem, Lipschitz Functions, Uniform Continuity of Lipschitz Functions, converse, The Continuous Extension Theorem, Approximation by step functions & piecewise linear functions, Weierstrass Approximation Theorem (only statement)

8.1 : Pointwise and Uniform Convergence-definition, illustrations, The Uniform Norm, Cauchy Criterion for Uniform Convergence

9.4: Series of Functions – (A quick review of series of real numbers of section 3.7 without proof) definition, sequence of partial sum, convergence, absolute and uniform convergence, Tests for Uniform Convergence , Weierstrass M-Test (only upto and including 9.4.6)

References:

1	Charles G. Denlinger: Elements of Real Analysis Jones and Bartlett Publishers Sudbury, Massachusetts (2011) ISBN:0-7637-7947-4 [Indian edition: ISBN-9380853157]
2	David Alexander Brannan: A First Course in Mathematical Analysis Cambridge University Press,US(2006) ISBN: 9780521684248
3	John M. Howie: Real Analysis Springer Science & Business Media(2012) [Springer Undergraduate Mathematics Series] ISBN: 1447103416
4	James S. Howland: Basic Real Analysis Jones and Bartlett Publishers Sudbury, Massachusetts (2010) ISBN:0-7637-7318-2
5	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

SJSDC5MT17 COMPLEX ANALYSIS

5 hours/week 6 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

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 (20 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 (20hrs)

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 (20hrs)

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

Module-IV (30 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

SJSDC1AI02 – INTRODUCTION TO ARTIFICIAL INTELLIGENCE

5 hours/week 5 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

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. discuss the core concepts and algorithms of advanced AI, including informed searching, CSP, logic, uncertain knowledge and reasoning, dynamic Bayesian networks, graphical models, decision making, multiagent, 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 (25hrs)

Introduction: What is Artificial Intelligence? Foundations of AI, history, the state of art AI today. Intelligent Agents: agents and environment, good behavior, nature of environment, the structure of agents

Solving Problems by Searching: Problem solving agents, examples problems, searching for solutions, uninformed search, informed search strategies, heuristic functions.

Beyond Classical Search: local search algorithms, searching with non-deterministic action, searching with partial observations, online search agents and unknown environments.

Module-II (25hrs)

Knowledge Representation Issues : Representations And Mappings, Approaches To Knowledge Representation.

Using Predicate Logic : Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution.

Representing Knowledge Using Rules : Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Statistical Reasoning : Probability And Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory, Fuzzy Logic.

Module-III (25hrs)

Weak Slot-and-Filler Structures : Semantic Nets, Frames.

Strong Slot-and-Filler Structures : Conceptual Dependency, Scripts, CYC

Game Playing: Overview, And Example Domain : Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques.

Understanding: What is understanding? , What makes it hard?, As constraint satisfaction

Module-IV (20hrs)

Natural Language Processing : Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking

Connectionist Models : Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.

Introduction to Prolog : Introduction To Prolog: Syntax and Numeric Function, Basic List

Manipulation Functions In Prolog, Functions, Predicates and Conditional, Input, Output and Local Variables, Iteration and Recursion, Property Lists and Arrays, Miscellaneous Topics, LISP and Other AI Programming Languages.

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

FIRST SEMESTER

SJSDC1AI03 – PYTHON PROGRAMMING WITH DATA STRUCTURE

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

CO 1. Understand how to read/write to files, handle exception using python.

CO 2. Build package Python modules for reusability.

CO 3. Design and understand object-oriented concepts with Python classes.
CO 4. Understand the concept of pattern matching.
CO 5. Understand the advantage of using python libraries for implementing machine learning models

Syllabus

Module-I (18hrs)

Review of Important Python Concepts ,Classes, String, Tuples, Lists, Dictionaries, sorting, handling exceptions, using iPython

Module-II (18hrs)

Machine Learning Algorithms with Scikit-learn ,Pandas Library, Using Scikit-Learn for Logistic Regression, Support Vector Machines, Building Neural Networks

Module-III (18hrs)

Introduction to Tensor Flow ,Concept of Computational Graph and Nodes, Virtual Environment and Anaconda, Installing TensorFlow with GPU support on a Linux System, TF Datatypes, Placeholders, TF Variables, TF Session, Softmax, One Hot Encoding, Dropout, building hidden layers,Batching, Stochastic Gradient Descent, Building an Optimizer, Training and displaying results

Module-IV (18hrs)

Building a Neural Network with Tensor Flow ,Using inbuilt TensorFlow functionality to build a Neural Network and train on MNIST Dataset for classification

References:

1	Python Machine Learning, Sebastian Raschka
2	Getting Started with TensorFlow, Giancarlo Zaccone
3	Allen Downey. (2012). Think Python. Needham, Massachusetts: O'Reilly.
4	Allen Downey. (2012). Think Python.Retrieved from http://www.greenteapress.com/thinkpython/thinkpython.pdf
5	Goodrich, Tamassia, Goldwasser.(2016).Data Structures and Algorithms in Python: J. Wiley.
6	Wiley.Rance D. Necaise, College of William and Mary.(2016).Data Structures and Algorithms Using Python:

FIRST SEMESTER

SJSDC1AI03(P) – PYTHON PROGRAMMING WITH DATA STRUCTURE (LAB)

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Practical List

1.
   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. Programs using break and continue statements.
2.
   a. Programs related to string manipulation.
   b. Programs using list comprehensions and anonymous functions.
3.
   a. Programs related to dictionaries.
   b. Programs using the built-in methods of the string, list and dictionary classes
4.
   a. Design a class that store the information of Employee and display the same.
   b. Implement the concept of inheritance using python.
5.
   a. Programs to read and write files.
   b. Program to demonstrate exception handling
6. Program to demonstrate the use of regular expressions
7. Modules

a) Write a program to implement userdefined module.

b) Write a python program to demonstrate random module.

c) Write a program to demostrate time module.

8. Program to show draw shapes & GUI controls.

9.

a) Design a simple database application that stores the records and retrieve he same.

b) Design a database application to search the specified record from the database.

c) Design a database application to that allows the user to add, delete and

10.

a. Write a program to implement stack and its applications.

b. Write a program to implement queue and its applications.

11. Write a program to implement linked list and its applications.(singly, doubly)

12.

a. Write a program to perform insertion and deletion of a node from a tree.

Write a program to print pre-order, post-order and in-order traversal of a tree modify the records.

SECOND SEMESTER

SJSDC2AI06 - DESIGN AND ANALYSIS OF ALGORITHMS

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

CO 1. To survey algorithmic strategies give presentations using open source documentation tools like Latex and soft skill methodologies.

CO 2. To write mathematical modeling of algorithms for problem solving.

CO 3. To develop SRS in the UG projects;

CO 4. To solve problems for multi-core or distributed or concurrent/Parallel/Embedded environments;

Syllabus

Module-I (18hrs)

Problem solving and Algorithmic Analysis 6 Problem solving principles: Classification of problem, problem solving strategies, classification of time complexities (linear, logarithmic etc) problem subdivision – Divide and Conquer strategy. Asymptotic notations, lower bound and upper bound: Best case, worst case, average case analysis, amortized analysis. Performance analysis of basic programming constructs. Recurrences: Formulation and solving recurrence equations using Master Theorem.

Module-II (18hrs)

Greedy and Dynamic Programming Algorithmic Strategies: Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem, scheduling algorithms-Job scheduling and activity selection problem. Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomial coefficients, OBST, 0/1 knapsack, Chain Matrix multiplication.

Module-III (18hrs)

Backtracking and Branch-n-Bound 8 Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem. Branch-n-Bound: Principle, control abstraction, time analysis of control abstraction, strategies – FIFO, LIFO and LC approaches, TSP, knapsack problem

Complexity Theory

Overview: Turing machine, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P class, NP class & NP complete problems- vertex cover and 3-SAT and NP–hard problem – Hamiltonian cycle. The menagerie of complexity classes of Turing degrees. Concept of randomized and approximation algorithms: Solving TSP by approximation algorithm, Randomized sort algorithms and Approximating Max Clique.

Module-IV (18hrs)

Parallel and Concurrent Algorithms 6 Parallel Algorithms: Sequential and parallel computing, RAM & PRAM models, Amdahl's Law, Brent's theorem, parallel algorithm analysis and optimal parallel algorithms, graph problems (shortest paths and Minimum Spanning Tree, Bipartite graphs) Concurrent Algorithms: Dining philosophers problem

Algorithmic Case-studies 8 Distributed Algorithms: Bully algorithm – method for dynamically selecting a coordinator, all pair shortest path (Floyed-Warshall Algorithm), Dijkstra-Scholten algorithm – detection of process termination, Buddy memory algorithm – method to allocate memory. Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems. Internet of Things and Data Science Algorithms: Algorithms in IoT: Cryptography Algorithms, Scheduling Algorithms, Data management Algorithms and clustering, context management. Data Science Project Life Cycle(DSPLC), Mathematical Considerations: Mathematical modeling, Optimization Methods, Adaptive and Dynamic Algorithms and Numerical Analysis in IoT Algorithms in Software Engineering: String matching algorithmBoyer-Moore algorithm KMP algorithm.

References:

1	Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2ND Edition. University Press, ISBN: 978 81 7371 6126, 81 7371 61262.
2	Gilles Brassard and Paul Bartley, "Fundamental of Algorithmics", PHI, New Delhi
3	Algorithms, Kenneth Berman and Jerome Paul, Cenage Learning, ISBN-13 978-81-315-0521-2

SECOND SEMESTER

SJSDC2AI06(P) DESIGN AND ANALYSIS OF ALGORITHMS(LAB)

4 hours/week 3 Credits 100 Marks [Int:20+Ext :80]

Practical List

1. (a) Write a program to implement depth first search algorithm.

(b) Write a program to implement breadth first search algorithm.

2. (a) Write a program to simulate 4-Queen / N-Queen Problem.

(b)Write a program to solve tower of Hanoi Problem.

3. (a) Write a program to implement alpha beta search.

(b) Write a program for Hill climbing problem.

4. (a) Write a program to implement A*algorithm.

(b) Design the simulation of tic –tac –toe game using min-max algorithm.

5. (a) Design an application to simulate number puzzle problem.

b) Write the Conceptual Dependency for following statements.

(a) John gives Mary a book

(b) John gave Mary the book yesterday

6. (a) Solve the block of Word Problem. 3

(b) Solve constraint satisfaction problem 3

7. a.Install nltk(python)

b.Count word Frequency: Plot the graph for most frequently occurring words in the webpage in order to get the clear picture of the context of the web page(python)

c.Using the NLTK tool perform stemming and lemmatization(NLP for text).

8. Mini Project based on Python programming

THIRD SEMESTER

SJSDC3AI09 INTRODUCTION TO MECHINE LEARNING

4 hours/week 5 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

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 implementtypical Clustering algorithms for different types of applications.

Syllabus

Module-I (18hrs)

Introduction-Idea of Machines learning from data, Classification of problem – Regression and Classification, Supervised and Unsupervised learning , Problems, data, and tools; Visualization,; SSE; gradient descent; closed form; normal equations; features ,Overfitting and complexity; training, validation, test data

Module-II (18hrs)

Linear Regression-Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Multivariable model representation, Multivariable cost function, Gradient Decent in practice, Normal Equation and non-invertibility

Logistic Regression -Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting, Regularization

Module-III (18hrs)

Classification problems; decision boundaries; nearest neighbor methods, Logistic regression,

Unsupervised learning: clustering, k-means, hierarchical agglomeration,Advanced discussion on clustering and EM , Latent space methods; PCA,Text representations; naive Bayes and multinomial models; clustering and latent space models,Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian classconditional distribution, Linear classifiers -Bayes' Rule and Naive Bayes Model

Module-IV (18hrs)

Online gradient descent, Neural Networks, Decision tree, Ensemble methods: Bagging, random forests, boosting, A more detailed discussion on Decision Tree and Boosting, Support Vector Machines, Regularization,

In practice: Advice for Applying Machine Learning, Dimensionality Reduction, Anomaly Detection,Recommender Systems

References:

1	"Understanding Machine Learning:From Theory To Algorithms,2017 By Shai ShalevShwartz And Shai Ben-David
2	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
3	The Elements of Statistical Learning. Trevor Hastie,Robert Tibshirani and Jerome Friedman
4	Pattern Reognition &Machine Learning ,Christopher Bishop,Spring

THIRD SEMESTER

SJSDC3AI10 ADVANCED PYTHON PROGRAMMING

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

CO 1. Understand how to read/write to files, handle exception using python.

CO 2. Build package Python modules for reusability.

CO 3. Design and understand object-oriented concepts with Python classes.

CO 4. Understand the concept of pattern matching.

CO 5. Understand the advantage of using python libraries for implementing machine learning models

Syllabus

Module-I (18hrs)

Review of Important Python Concepts ,Classes, String, Tuples, Lists, Dictionaries, sorting, handling exceptions, using iPython

Module-II (18hrs)

Machine Learning Algorithms with Scikit-learn ,Pandas Library, Using Scikit-Learn for

Logistic Regression, Support Vector Machines, Building Neural Networks

Module-III (18hrs)

Introduction to Tensor Flow ,Concept of Computational Graph and Nodes, Virtual Environment and Anaconda, Installing TensorFlow with GPU support on a Linux

System, TF Datatypes, Placeholders, TF Variables, TF Session, Softmax, One Hot Encoding, Dropout, building hidden layers,Batching, Stochastic Gradient Descent, Building an Optimizer, Training and displaying results

Module-IV (18hrs)

Building a Neural Network with Tensor Flow ,Using inbuilt TensorFlow functionality to build a Neural Network and train on MNIST Dataset for classification

References:

1	Python Machine Learning, Sebastian Raschka
2	Getting Started with TensorFlow, Giancarlo Zaccone
3	Allen Downey. (2012). Think Python. Needham, Massachusetts: O'Reilly.
4	Allen Downey. (2012). Think Python.Retrieved from http://www.greenteapress.com/thinkpython/thinkpython.pdf
5	Goodrich, Tamassia, Goldwasser.(2016).Data Structures and Algorithms in Python: J. Wiley.
6	Wiley.Rance D. Necaise, College of William and Mary.(2016).Data Structures and Algorithms Using Python:

THIRD SEMESTER

SJSDC3AI10(P) – ADVANCED PYTHON PROGRAMMING (LAB)

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

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 .

FOURTH SEMESTER

SJSDC4AI13 DEEP LEARNING & NEURAL NETWORK

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

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

CO 4. Design and implement Convolutional Neural Networks.

Syllabus

Module-I (18hrs)

Basic concept of Neurons –Perceptron Algorithm –Feed Forward and Back Propagation Networks.

Introduction to Deep Learning, Modular approaches, Backpropagation, Optimization,Introduction to Convolutional Neural Networks (CNN)- Introduction to CNN,CNN architectures, Long Short-Term Memory Networks (LSTMs), Stacked AutoEncoders, Deep Boltzmann Machine (DBM), Deep Belief Networks (DBN),Introduction to Recurrent Neural Networks - Sequence to sequence models,Concepts in natural language processing

Module-II (18hrs)

INTRODUCTION TO NEURAL NETWORKS: Introduction, Humans and Computers,

Organization of the Brain, Biological

Neuron, Biological and Artificial Neuron Models, Characteristics of ANN,

McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

Module-III (18hrs)

SINGLE LAYER FEED FORWARD NETWORKS: Introduction, Perceptron Models:

Discrete, Continuous and Multi-Category,

Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.

MULTI- LAYER FEED FORWARD NETWORKS: Credit Assignment Problem, Generalized Delta Rule, Derivation of

Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Module-IV (18hrs)

ASSOCIATIVE MEMORIES: Paradigms of Associative Memory, Pattern Mathematics,

Hebbian Learning,

General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function.

Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis. Neural network applications: Process identification, control, faultdiagnosis.

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

FOURTH SEMESTER

SJSDC4AI13(P) - DEEP LEARNING & NEURAL NETWORK (LAB)

4 hours/week 3 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 SimpleLSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN

FIFTH SEMESTER

SJSDC5AI18 REINFORCEMENT LEARNING

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

CO 1. Understand basic concepts in reinforcement learning
CO 2. Understand band width Algoritm in statistical background
CO 3. Apply statistical tools in the reinforcement learning
CO 4. Understand basic mathematical foundations of reinforcement learning

SYLLABUS

Module-I (18hrs)

Introduction to RL and Immediate RL:
Introduction to RL
RL framework and applications
Introduction to immediate RL
Bandit optimalities
Value function based methods

Bandit Algorithms
UCB 1

Concentration bounds
UCB 1 Theorem
PAC bounds
Median elimination
Thompson sampling

Module-II (18hrs)

Policy Gradient Methods & Introduction to Full RL

Policy search

REINFORCE

Contextual bandits

Full RL introduction

Returns, value functions & MDPs

MDP Formulation, Bellman Equations & Optimality Proofs

MDP modelling

Bellman equation

Bellman optimality equation

Cauchy sequence & Green's equation

Banach fixed point theorem

Convergence proof

Module-III (18hrs)

Dynamic Programming & Monte Carlo Methods

LPI convergence

Value iteration

Policy iteration

Dynamic programming

Monte Carlo
Control in Monte Carlo

Function Approximation

Function approximation
Linear parameterization
State aggregation methods
Function approximation & eligibility traces
LSTD & LSTDQ
LSPI & Fitted Q

DQN, Fitted Q & Policy Gradient Approaches

DQN & Fitted Q-iteration
Policy gradient approach
Actor critic & REINFORCE
REINFORCE (cont'd)
Policy gradient with function approximation

Module-IV (18hrs)

Hierarchical Reinforcement Learning

Hierarchical reinforcement learning
Types of optimality
Semi-Markov decision processes
Options
Learning with options
Hierarchical abstract machines

Hierarchical RL: MAXQ

MAXQ

MAXQ value function decomposition

Option discovery

References:	
1	D.P.Bertsekas, Dynamic Programming and Optimal Control, Vol. I, Athena Scientific, 2017
2	D.P.Bertsekas, Dynamic Programming and Optimal Control, Vol. II, Athena Scientific, 2012
3	D.P.Bertsekas and J.N.Tsitsiklis, Neuro-Dynamic Programming, Athena Scientific, 1996
4	R.S.Sutton and A.G.Barto, Reinforcement Learning: An Introduction, MIT Press, 1998. For an updated draft,

FIFTH SEMESTER

SJSDC5AI19 IOT PROGRAMMING

4 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

Course Outcome

CO 1. Enable learners to understand System On ChipArchitectures.
CO 2. Introduction and preparing Raspberry Pi with hardwareandinstallation.
CO 3. Learn physical interfaces and electronics of Raspberry Piandprogram them usingpractical's
CO 4. Learn how to make consumer grade IoT safe and secure withproperuse ofprotocols

SYLLABUS

Module-I (18hrs)

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 (18hrs)

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 (18hrs)

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 (18hrs)

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

SJSDC5AI18(P) REINFORCEMENT LEARNING (LAB)

3 hours/week 3 Credits 100 Marks [Int:20+Ext:80]

PRACTICAL LIST

1. Implement Dynamic Programming Policy Evaluation
2. Implement Dynamic Programming Policy Iteration
3. Implement Dynamic Programming Value Iteration
4. Implement Monte Carlo Prediction
5. Implement Q-Learning (Off Policy TD Learning)
6. Implement Q-Learning with Linear Function Approximation
7. Implement Deep Q-Learning for Atari Games
8. Implement Double Deep-Q Learning for Atari Games
9. Deep Q-Learning with Prioritized Experience Replay (WIP)

FIFTH SEMESTER

SJSDC5AI19(P) – IOT PROGRAMMING LAB

4 hours/week 3 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 LEDpatterns with RaspberryPi.
5. Displaying time over 4 digit 7 segment display using RaspberryPi
6. SPI: Camera Connection and capturing Images usingSPI
7. Interfacing Raspberry Pi withRFID.
8 .Node RED: Connect LED to Internet ofThings
9. Visitor monitoring with RaspberryPi and PiCamera.
10 .Create a simple Web server using RaspberryPi