SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)

CHENNAI - 600044.

Re accredited with A+ Grade by NAAC

MASTER OF SCIENCE

(Self Support)

Under the faculty of Arts/ Science/ Commerce

M.Sc. APPLICABLE MATHEMATICS

CHOICE BASED CREDIT SYSTEM (CBCS)
OUTCOME BASED EDUCATION (OBE)

(Effective from the Academic Year 2020-21)

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RULES AND REGULATIONS

DEPARTMENT OF APPLICABLE MATHEMATICS

Revised Syllabus of 2020 - 2021

OBJECIVES OF THE COURSE:

- **To enhance** students with a knowledge, abilities and insight in Mathematics and computational techniques so that they are able to work as mathematical professional also prepares them to pursue higher studies and conduct research.
- **To Increase** student's self-confidence in conducting research independently or withinateam.

PG REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

B.Sc. Degree with Mathematics / Statistics / Computer Science as Main Subject.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than two academic years, passed the examinations all the four-Semesters prescribed earning a minimum of 91 Credits (in Parts-I & II)

3. DURATION:

a. Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters and the second academic year the third and fourth semesters.

b. The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

4. COURSE OF STUDY:

The main Subject of Study for Master Degree Courses shall consist of the following

PART – I CORE SUBJECTS, PROJECT/ELECTIVES

PART – II SOFT SKILLS & INTERNSHIP

1. Skill based subjects (Four) -

   a) Teaching Skills

   b) Research Skills

   c) Soft Skill – SWAYAM COURSE (MOOC)

   d) Soft Skill – SWAYAM COURSE (MOOC)

Recommended Credits Distribution: (Total should not be less than 91 Credits)

Course Type	**No. of Papers**	**Credits / Paper**	**Credits**
Core (Theory)	11	4	44
Core (Practical)	3	4	12
Core (Project)	1	4	4
Elective	5	3	15
Internship	1	2	2
Skill based courses	2	3	6
Swayam Courses	2	4	8
Total	**25**	**24**	**91**

5. ATTENDANCE

CATEGORY-A: ATTENDANCE REQUIREMENT

All candidates must put in 75% and above of attendance for Arts, Science, Commerce courses both UG/PG including MBA/MCA Degree courses for appearing the University Examination. (Theory/Practical)

CATEGORY –B: CONDONATION OF SHORTAGE OF ATTENDANCE

If a candidate fails to put in the minimum attendance (Percentage stipulated), the Principals

shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) for all UG/PG courses. (i.e. Arts Science, Commerce, MBA and MCA) after collecting the prescribed fee of RS.250/-each for Theory/Practical examination separately, (Theory Rs.250/- Per semester/Per Candidate: Practical Rs.250/- Per semester/ Per Candidate) towards the condonation of shortage of attendance.

CATEGORY-C: NOT ELIGIBLE FOR CONDONATION OF SHORTAGE OF ATTENDANCE

Candidates who have secured less than 65% but more than 50% of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such candidates will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the course and they may be permitted to take next University examination by paying the prescribed condonation fee of Rs.250/- each for Theory/Practical separately. Names of such candidates should be forwarded along with their attendance details in the prescribed format mentioning the category(3copies). Degree Wise/Year wise/Branch wise/semester wise/together with the fees collected from them. So as to enable them to get permission from the University and to attend the Theory/Practical examination subsequently without any difficulty.

CATEGORY-D: DETAINED STUDENTS FOR WANT OF ATTENDANCE

Candidate who have put in less than 50% of attendance have to repeat the course (by re-joining) for which they lack attendance without proceeding for II/III year as the case may be. Until they re-join the course and earn the required attendance for that particular semester/year, no candidates shall be permitted to proceed to the next year/next semester of the course under any circumstances. They have to obtain prior permission from the University to re-join the course.

Provided in case of candidates who are admitted form the academic year 2003 -2004 earning less than 50% of attendance in any one of the semesters due to any extraordinary circumstances such as medical ground, such candidates shall produce Medical Certificate issued by the authorized, Medical Attendant (AMA), duly certified by the Principal of the college shall be permitted to proceed to the next semester and to complete the course of study. Such candidates shall have to repeat the semester, which they have missed by re-joining after completion of final semester of the course, by paying the fee for the break of study ad prescribed by the University from time to time.

CATEGORY-E: CONDONATION OF SHORTAGE OF ATTENDANCE FRP MARRIED WOMEN STUDENTS

In respect of married women students undergoing UG/PG course, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed ad 55% instead of 65% if they conceive during their academic career. Medical certificate form the Doctor attached to the Government Hospital (D.G.O) and the prescribed fee of Rs.250%- therefor together with the attendance details shall be forwarded to this off ice to consider the condonation of attendance mentioning the category.

0% Attendance

The candidates who have earned 0% of attendance, have to repeat the course (by re-joining) without proceeding to succeeding semester and they have to obtain prior permission form the University to re-join the course immediately for which applications issued for the academic year.

6. BREAK IN STUDY

After enrolling into any of the courses offered by the college a student is allowed to be absent continuously for period of FIVE years (Max. Condonable period- from the day of enrolment) after which she forfeits her admission.

A student who wants to continue her study within the condonable break period can rejoin in the same semester in the EXISTING VACANCY after getting the permission from the Principal and subsequently from University of Madras. Such students should also get a letter from the respective Head of the Department stating that she is not repeating any paper which she has already completed in other semesters.

7. TRANSFER OF STUDENTS AND CREDITS:

Transfer from other Autonomous or Non-Autonomous college or from other University is allowed for the same program with same nomenclature provided there is a vacancy in the respective program of study and the student has passed all the examinations under the previous system. **Students with standing arrears are NOT eligible for transfer.**

The marks obtained in the previous system will be converted and grades will be assigned as per the University norms.

Such students **are eligible** for classification.

Such student is NOT eligible for ranking, prizing and medals on qualifying the PG degree.

8. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS

1) Candidate shall register their names for the First Semester Examination after the admission in the M.Sc. Applicable Mathematics Course.

2) Candidates shall be permitted to proceed from the first semester up to the final Semester irrespective of their failure in any of the Semester Examinations subject to the condition that the candidate should register for all arrear subjects of earlier semesters along with current (subject) semester subjects.

3) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed by the University/College.

9. PASSING REQUIREMENTS

1. There shall be no passing minimum for Internal. But 0 also should not be awarded. In case a student absents herself for all the CIA exams and ends in getting 0 in internal in a particular subject, she will be awarded 1 or 2 marks for attendance.

2. For all subjects (Theory/Practical/Project) the passing requirement is as follows: i) candidate should secure not less than 50% of marks in End Semester Examination (ESE) and not less than 50% in aggregate of the total internal and external marks.

3. A candidate who passes in all subjects earning 91 credits within the maximum period of four years reckoned from the date of admission to the course shall be declared to have qualified for the degree.

4. A student who fails in either Project work or Viva-voce shall be permitted to redo the project work for evaluation and re-appear for the Viva-voce on a subsequent occasion, if so recommended by the examiners.

5. Grading shall be based on overall marks obtained (Internal + External)

10. MEDIUM OF INSTRUCTION AND EXAMINATIONS

The medium of instruction and examinations for the papers of Part I & II shall be the language concerned. For part I subjects other than modern languages, the medium of instruction shall be either Tamil or English and the medium of examinations is in English/Tamil irrespective of the medium of instruction. For modern languages, the medium of instruction and examination will be in the languages concerned.

11. SUBMISSION OF RECORD NOTE BOOKS FOR PRACTICAL EXAMINATIONS

Candidates appearing for practical examinations should submit bonafide Record Note Books prescribed for practical examinations, otherwise the candidates will not be permitted to appear for the practical examinations.

12. CLASSIFICATION OF SUCCESSFUL CANDIDATES

1. A Candidate who qualifies for the Degree and secures CGPA between 9.0 – 10.0 shall be declared to have passed the examination in FIRST CLASS - EXEMPLARY provided she has passed the examination in every subject she has registered as well as in the project work in the first appearance.

2. A Candidate who qualifies for the Degree and secures CGPA between 7.5 – 8.9 shall be declared to have passed the examination in FIRST CLASS WITH DISTINCTION provided she has passed the examination in every subject he/she has registered as well as in the project work in the first appearance.

3. A candidate who qualifies for the degree as per the regulations for passing requirements and secures CGPA between 6.0 – 7.4 shall be declared to have passed the examination in FIRST CLASS

4. A candidate who qualifies for the degree as per the regulations for passing requirements and secures CGPA between 5.0 –5.9 shall be declared to have passed the examination in SECOND CLASS

5. Only those candidates who have passed all the papers including practical and project work in the first appearance shall be considered for the purpose of RANKING.

13. RANKING

1. Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction.

2. Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to lack of attendance are only eligible for classification.

14. GRADING SYSTEM

The term grading system indicates a SEVEN (7) point scale of evaluation of the performance of students in terms of marks obtained in the Internal and External Examination, Grade points and letter grade.

Minimum Credits to be earned:

For TWO year PG Programme: Best 91 Credits (Part I: Major/Elective, Part –II: Soft skills)

Conversion of Marks to Grade Points and Letter Grade

(Performance in a Course / Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
40-49	4.0-4.9	U	Re-appear
ABSENT	0.0	AAA	ABSENT

15. CLASSIFICATION & CALCULATION OF GPA AND CGPA

For a Semester :

GRADE POINT AVERAGE [GPA]

$$GPA = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

For the entire programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA]

Sum of the multiplication of grade points by the credits of the courses

For entire programme

$$CGPA = \frac{\text{Sum of the credits of the courses of the entire programme}}{}$$

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O+	First Class - Exemplary *
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction *
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

* The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme (Major, Elective/Project and Non-Major Elective courses alone) / M.Phil. are eligible.

16. ESE REVALUATION

A student is eligible to appeal for revaluation of the paper only **if she secures a minimum of 10 in the internal tests (CAT) of that paper** if the internal maximum marks is 25 and **a minimum of 6 in the internal tests (CAT) of that paper** if the internal marks is 15. This has to be done within 10 days from the publication of results. She also has to pay the prescribed fee. The revaluation will be done by an external examiner appointed by the Principal.

17. ARREAR / REPEAT EXAMINATIONS

1. A candidate having arrear paper(s) shall have the option to appear along with the regular semester papers.

2. Candidates who fail in any of the papers in Part I & II of PG degree examinations shall complete the paper concerned within **four** years from the date of admission to the said course.

18. SUPPLEMENTARY / INSTANT EXAMINATION

1. Final year students (PG – II year 4th semester) are **only** eligible to apply for Supplementary / Instant Examination.

2. Students who have only one paper as arrear in the final semester are allowed to take up supplementary / instant examination.

3. Supplementary / Instant Examination will not be conducted for practical papers and projects.

19. CONCESSIONS FOR DIFFERENTLY-ABLED STUDENTS

1. Students who are mentally disabled, learning disability and mental retardation, who are slow learners, who are mentally impaired having learning disorder and seizure disorder and students who are spastic and cerebral palsy the following concessions shall be granted obtaining prior permission from the University
    a. One-third of the time of paper may be given as extra time in the examination.
    b. Leniency in overlooking spelling mistakes
2. Students who are visually challenged
    a. Exempted from paying examination fees.
    b. A scribe shall be arranged by the college and the scribe be paid as per the college decision.

20. MALPRACTICE

The College views malpractice of any kind very seriously. The college has a Malpractice committee consisting of four senior staff members. Students found to be directly or indirectly involved in malpractice of any kind during examinations will be subject to penalty of very high proportions.

21. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMME TO QUALIFY FOR A DEGREE:

1. A student who for whatever reasons is not able to complete the programme within the normal period (N) or minimum duration prescribed for the programme, may be allowed **TWO** year period beyond the normal period to clear the backlog to be qualified for the degree. (Time span is N + 2 years for completion of the programme)

2. In exceptional cases like major accidents and child birth, an extension of **ONE** year be considered beyond maximum span of time that is **N + 2 + 1**. Students qualifying during the extension period are **NOT** eligible for ranking.

22. REGULATORY BODIES

Under autonomy, the college is free to frame its curriculum and conduct examinations. These functions are monitored by the **Board of Studies, Board of Examiners and the Academic Council.**

Board of Studies

Separate Board of studies are constituted for each programme offered by a department. Each Board of Studies will meet at least once a year to design courses, modify syllabi / examination pattern and recommend the same to the Academic Council.

The Board of Studies is composed of :

- Head of the Respective Department (Chair Person)
- One subject expert from within parent University- as nominated by the Vice – Chancellor from a panel of recommended members(University Nominee)
- Two Senior staff member of each specialization apart from Chair person.
- Two subject experts from outside Parent University.
- One representative from the Industry / Corporate sector / allied area relating to placement
- One meritorious alumnus
- One student representative from current batch (preferably a meritorious final year Student.
- The faculty of the department

The tenure of the external experts is for TWO years.

Board of Examiners

A list of board of examiners is obtained by circulating the details of courses offered by the college to other colleges and through the list provided by the departments. Single valuation is done for UG courses and double valuation, one Internal and one External, for PG courses.

Academic Council

The Academic Council is composed of:

- The Principal (Chairman)
- All heads of the department in the college
- Four senior teachers of the college representing different categories of teaching
- Four representatives from the Industry / Corporate sector / allied area relating to placement / Commerce / Law / Education / Medicine / Engineering nominated by the Governing Body
- Three nominees of the University of Madras
- A faculty member nominated by the principal (Member Secretary)

The term of the nominated members shall be TWO years.

20. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: **To enhance** students with a knowledge, abilities and insight in Mathematics and computational techniques so that they are able to work as mathematical professional also prepares them to pursue higher studies and conduct research.

PEO2: **To apply** critical and logical reasoning and to present concise arguments needed for research in Mathematics and its associated subfields**.**

PEO3: **To Develope** investigative, communicative and presentation skills and take options to work on real life challenging problems.

PEO4: **To enlighten** student's self-confidence in conducting research independently or within a team.

PEO5: **To Recognize** and learn the importance of life-long learning.

21. PROGRAMME OUTCOMES (POs)

PO 1-Identify and analyze the complex problems reaching substantiated conclusions using domain knowledge.

PO 2-Apply investigative research, specialize in problem identification, formulate research design, utilise analytical tools, draw valid inferences and provide suggestions leading to nation building initiatives.

PO 3-Strengthen professional ethics and career planning with systematic building of intrapersonal and interpersonal skills to participate in the intellectual diasporas.

PO 4-Establish oneself as a self-reliant, empowered individual to have an inclusive, healthy and compassionate understanding towards life and society.

PO 5-Equipped with technical / managerial expertise to innovate and critically analyse various attributes which constitute pivotal issues in a multidisciplinary scenario.

PO 6-Emerge as innovators and pioneers to create new avenues of employment catering to the global trends as well as demands.

22.PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Demonstrate the ability to conduct research independently and pursue higher studies towards Research in Mathematics and computing.

PSO2: Carry out applications of Mathematics in the field of Network Analysis, Optimization techniques and other related fields.

PSO3: Demonstrate competence in using mathematical and computational skills to model, formulate and solve real life applications.

PSO4: Ability to acquire knowledge and skills through self learning that helps in personal and skill development suitable for changing demands of work place.

PSO5: Enable students to develop a range of common skills which in turn will be helpful in wage employment, self employment and entrepreneur ship.

PSO6: Acquire deep knowledge of different mathematical disciplines so that they can qualify Competitive Examination.

23. QUESTION PAPER PATTERN:

QUESTION PAPER PATTERN FOR OBE

(2020-21 onwards)

Theory

PG –Question paper Pattern- conventional on- paper mode.

Bloom's Category Level	**Sections**	**Marks**	**Word limit**	**Total**	**Meaning of K's**
K1, K2	Section A Multiple Choice Questions 15 questions *2	30	Correct choice	75	K 1 & K2 - Understanding Level K 3 - Apply Level K 4 - Analyze Level K 5 – Evaluate Level K 6 – Create Level
K3, K4	Section B 5 Questions out of 7 questions *5 Marks	25	Short answers {approx.500 Words)		
K4, K5,k6	Section C 1 out of 3 Questions *10 Marks + Compulsory Question 10 Marks	20	Elaborate answers (approx.1000 Words)		

*** 75 marks to be converted as 60 marks.**

UG /PG QUESTION PAPER PATTERN FOR OBE ONLINE

ASSESSEMENT (2020 - 2021)

Bloom's Category Level	Sections	**Marks**	Description of answer	**Total**	**Meaning of K's**
INTERNAL SETTING					
K1, K2, K3	**Section A** Multiple Choice Questions 25 Questions *1 Marks (No Choice)	25X1=25	Choose the write option.	50	K1 & K2 - Understanding Level K 3 - Apply Level K 4 - Analyze Level K 5 – Evaluate Level K 6 – Create Level
EXTERNAL SETTING					
K2, k3, K4, K5, K6	**Section B** 5 out of 7 Questions *5 Marks	25	Short answers/500 Words		

*** 50 marks to be converted as 60 marks.**

BLOOM'S CATEGORY LEVEL (ANNEXURE chart)

S.no	K component scale	Verbs for question
I.	**K 1& K2 Verbs**	Verbs to be used for questioning are "choose, find, identify, indicate, match, name, state, what, when, where, which, who, cite, label, reproduce. define, list, quote, revise, explain, show, sketch, illustrate, interpret, describe, substitute, convert, give example, rephrase
2.	**K2 &k3**	The questions may contain the verbs such as explain, show, sketch, illustrate, interpret, describe, substitute, convert, examFle, rephrase, apply, relate, solve, classify, predict, compute, prepare
3.	**K4**	The questions may contain verbs - Apply, relate, solve, classify, predict, compute, prepare.
4.	**K5**	The questions may contain any of the following verbs : Ascertain, diagnose, distinguish, infer, associate, examine, differentiate, reduce, discriminate, dissect, determine, justify, organize, recommend, solve.
5	**K6**	The questions may contain any of the following verbs: Appraise, conclude, critique, judge, assess, contrast, deduce, weigh. Compare, criticize, evaluate.

Question paper pattern for Continuous Assessment Test (CAT)

(The online assessment pattern)

UG / PG PROGRAMME

SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN

M.Sc DEGREE EXAMINATION,MARCH , 2020-2021.

I YEAR I SEMESTER

CAT – I/II/III

Sub Title: Max. Marks: 50

Sub Code: Date:

Time: 2hrs.

Question paper Pattern-Two Components: (Max marks=50) – 2 hrs

I. **Multiple Choice Questions (MCQ) - 20 marks (10x2=20)**
II. **Google Class Room (GCR) - 30 marks (**Structured)

   A. **Section A: 5 out of 6 – each carries 2 marks (5x2=10)**
   B. **Section B: 4 out of 5 – each carries 5 marks (4x5=20)**

- The answers for the questions for QP uploaded in GCR will be as uploads (images of hand written answer sheets converted to .pdf) in Google Class Room.
- The duration for each GCR session (answering and uploading) would be 3 hours (maximum).
- The structured component (30 marks) SHOULD be conducted in GCR as per the CAT schedule.MCQ (10X2=20) CAN be conducted out of schedule also, but should be completed during the CAT examination scheduled.

Note: The GCR question paper and MCQ assessment links to be shared with the COE office for approval and validity on or before the respective allotted dates.

PROGRAMME PROFILE
M.Sc. Applicable Mathematics

Total Credits:91 **Total Teaching Hours:120**

PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
I SEMESTER							
CORE T I		ALGEBRA-I	20PAMCT1A01	5	1	6	4
CORE T II		REAL ANALYSIS	20PAMCT1A02	5	1	6	4
CORE T III		PROGRAMMING IN C++	20PAMCT1003	4	2	6	4
CORE P I (AS applicable)		COMPUTATIONAL LABORATORY I	20PAMCP1001	4		4	4
ELECTIVE I		PROBABILITY AND DISTRIBUTIONS	20PAMET1001	5	1	6	3
SKILL BASED ELECTIVE		TEACHING SKILLS	18PSSTS1001		2	2	3
						30	**22**
		TOTAL					
II SEMESTER							
CORE T IV		ALGEBRA II		5	1	6	4
CORE T V		TOPOLOGY		5	1	6	4
CORE T VI		PROGRAMMING IN JAVA		4	2	6	4
CORE P II (as applicable)		COMPUTATIONAL LABORATORY II		4		4	4
ELECTIVE II		MATHEMATICAL STATISTICS		5	1	6	3
SOFT SKILL		SWAYAM (MOOC)			2	2	4
INTERNSHIP							2
		TOTAL				**30**	**25**
III SEMESTER							
CORE T VII		COMPLEX ANALYSIS		5	1	6	4
CORE T VIII		DIFFERENTIAL EQUATIONS		5	1	6	4
CORE T IX		CLASSICAL MECHANICS		5	1	6	4
ELECTIVE III		PYTHON PROGRAMMING		4	2	6	3
CORE P II		COMPUTATIONAL LABORATORY III		4		4	4
SOFT SKILL		RESEARCH SKILLS			2	2	3
		TOTAL				**30**	**22**
IV SEMESTER							

CORE T X		FUNCTIONAL ANALYSIS		5	1	6	4
CORE T XI		DIFFERENTIAL GEOMETRY AND TENSOR CALCULUS		5	1	6	4
ELECTIVE IV		CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS		4	2	6	3
Core Project		PROJECT		4		4	4
ELECTIVE V		OPERATIONS RESEARCH		4	2	6	3
SOFT SKILL		SWAYAM (MOOC)			2	2	4
		TOTAL				**30**	**22**

L =Lecture Hrs; T = Tutorial Hrs; H = Hrs. per week; C =Credits

RUBRICS FOR CONTINUOUS ASSESSMENT

Assignment
Seminar
Participatory Learning
Group Discussion
Flipped /B lended Learning

Assessment Model (from 2020 – 21 onwards)
Post graduation programme
40% Internal 60% External

S.No	Assessment Component	Marks	Weighted %
A.	**Theory**		
1	**INTERNAL ASSESSMENTS**		
	Continuous Assessment Test(best two out of three)	2 x 50 = 100	15
2	Quiz/Group Discussion/Seminar/Assignment/Role Play/ Case Study/ Open Book/ snap Test/ Video Presentation/ Review (any three to be considered)	3 x 10 = 30	15
3	MCQ (one test to be conducted online during the semester)	20	10
4	**EXTERNAL ASSESSMENT**		
	End semester examinations	75	60
	Grand Total		**100**
B	**Practical**		
1	INTERNAL ASSESSMENTS		
	Continuous Assessment Test(best two out of three)	2 x 50 = 100	15
2	Record + Observation	10 +10 = 20	15
3	MCQ (one test to be conducted online during the semester)	20	10
4	**EXTERNAL ASSESSMENT**		
	End semester Examinations	60	60
	Grand Total		**100**

DEPARTMENT OF APPLICABLE MATHEMATICS

SDNB VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)

CHENNAI–600044.

COURSE FRAME WORK

SEMESTER – I

S NO.	SUBJECT	PAPERS	TITLE OF THE PAPER	C	LH/W	CIA	ESE	T
1	CORE T I	1	ALGEBRA-I	4	6	40	60	100
2	CORE T II	1	REAL ANALYSIS	4	6	40	60	100
3	CORE T III	1	PROGRAMMING IN C++	4	6	40	60	100
4	CORE P I	1	COMPUTATIONAL LABORATORY I	4	4	40	60	100
5	ELECTIVE I	1	PROBABILITY AND DISTRIBUTIONS	3	6	40	60	100
6	SKILL BASED ELECTIVE	1	TEACHING SKILLS	3	2	50	-	100
		6		**22**	**30**			
TOTAL MARKS - MAJOR-400 ELECTIVE-100								

SEMESTER I

CORE PAPER I-ALGEBRA -1

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT1001**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES:

1. To introduce the concepts to develop working knowledge on groups, Normal subgroup, Automorphism groups, Finite groups and Rings.
2. To Provide student a good mathematical maturity and enables to build mathematical tinking and skills.
3. To prepare students to understand principles,concepts,necessary to formulate solve and analyze algebra.

COURSE OUTCOMES: On completion of the course the students will be able to…

CO No.	CO Statement
CO1	Explain sylow's theorem in the study of finite groups.
CO2	Analyze the class equations for finite groups and its applications.
CO3	Demonstrate the knowledge of direct product , finite abelian groups and the concepts of modules.
CO4	Explain the knowledge of the structures of finite fields and wedderburn's theorem on finite division rings.
CO5	Study a theorem on Frobenius, integral quaternions and the four square theorem.

SYLLABUS:

Unit-I: **15 Hrs.**

Another counting principle – class equation for finite groups and its applications – Sylow's Theorems (for theorem 2.12.1, first proof only)
Chapter 2: section 2.11 and 2.12 (Omit Lemma 2.12.5).

Unit-II: **15 Hrs.**

Solvable groups – Direct Products – Finite abelian groups – Modules
Chapter 5: section 5.7(Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1) Chapter 2: section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: section 4.5.

Unit-III: **15 Hrs.**

Trace and Transpose – Hermitian, Unitary, Normal Transformations.
Chapter 6: section 6.8 and 6.10

Unit-IV: **15 Hrs.**

Finite Fields – Wedderburn's theorem on finite division rings.
Chapter 7: Section 7.1 and 7.2 (theorem 7.2.1 only).

Unit-V: **15 Hrs**.

Solvability by Radicals – A theorem on Frobenius – integral quaternions and the four square theorem.

Chapter 5: Section 5.7(omit Lemma 5.7.1 Lemma 5.7.2 and Theorem 5.7.1).

Chapter 7: Section 7.3 and 7.4

Books for Study:

I.N. Herstein, 1975 Topics in Algebra (II Edition), John Wiley Eastern Limited, New Delhi.

Books for Reference:

1. Chales Lanski , 2010 concepts in Abstract, American Mathematical society , USA.
2. P.B. Bhattacharya , S.K.Jain and S.R. Noyapal 2009 – Basic Abstract Algebra – Cambridge University .
3. D.S.Dummit and R.M.Foote 2004 – Abstract Algebra – Willey.
4. John. B.Fraleigh 2003 A first course in Algebra , 7th edition , Addison – Wesley, New Delhi.
5. Lang Serge 2002 – Algebra-Addison Wesley.

E – Resources;

1. **http://people.math.harvard.edu/~nate/teaching/UPenn/2006/fall/math_371/lectures/week_2/lecture_2/lecture_2.pdf**
2. **https://www.math.ubc.ca/~lior/teaching/1516/322_F15/322_notes.pdf.**
3. **http://sporadic.stanford.edu/Math122/lecture10.pdf.**
4. **www. epgpathsala.com.**
5. **https://swayam.gov.in**

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	1	2	1	2	3
CO 2	3	3	3	2	1	2
CO 3	3	3	3	2	1	3
CO 4	3	2	2	2	0	3
CO 5	3	3	2	1	1	3
Average	3	2.4	2.4	1.6	1	2.8

PEDAGOGY:

Chalk & Talk, Power point presentation, Group Discussion, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

CORE PAPER II - REAL ANALYSIS

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT1002**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES:

1. To introduce the concepts of Measure Theory and main properties of the integral.
2. To demonstrate an understanding of convergence and how that are used in sequences, series and differentiation.
3. To enable the students to gain knowledge in Point wise convergence and Uniform Convergence.

COURSE OUTCOMES: On successful completion of the course the student will be able to

CO No.	CO Statement
CO1	Understand Measure Theory , Lebesgue and Riemann Integration which are essential mathematical concepts.
CO2	Apply the fundamentals of measure theory and be acquainted with the proofs of the fundamental theorems underlying the theory of integration.
CO3	Test the convergence of the series. Deep understanding of convergence, continuity, differentiation and integration . These concepts add to their strength of solving problems.
CO4	Achieve a good grasp of the basic concepts of contraction principle, Understand the of Inverse function theorem, Implicit function theorem.
CO5	Understand and analyze the Special Functions

SYLLABUS

Unit-I: **15 Hrs.**

Measure on the Real line : Lebesgue Outer Measure – Measurable sets – Regularity – Measurable Function – Borel and Lebesgue Measurability.

Chapter 2: Sections : 2.1 to 2.5.

Unit-II: **15 Hrs.**

Integration of Functions of a Real variable: Integration of Non-negative Functions – The General Integral –Riemann and Lebesgue Integrals.

Chapter 3: Sections : 3.1 to 3.4.(Omit Section 3.3)

Unit-III: **15 Hrs.**

Sequences and Series of Functions: Discussion of Main Problem – Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration - Uniform Convergence and Differentiation – Equicontinuous families of Functions – The Stone -Weierstrass Theorem.

Chapter 7: Sections:7.1 to 7. 27

Unit-IV: **15 Hrs.**

Functions of Several Variables: Differentiation – The Contraction Principle – The Inverse Function Theorem – The Implicit Function Theorem.
Chapter 9: Sections:9.10 to 9.28

Unit-V: **15 Hrs.**

Special Functions: Power Series-Exponential and Logarithmic Functions-Trigonometric Functions Fourier series-Gamma function.
Chapter 8:Sections: 8.1 to 8.7,8.9 to 8.22 (omit 8.8)

Books for Study:

1 G.deBarra 2003 Measure Theory And Integration, New age International, for Unit 1&unit 2) .
2. W. Rudin , 1976 Principles of Mathematical analysis,(3rd edition) , McGraw Hill Book Company, Newyork (for Unit 3 Unit 4 and Unit 5).

Books for Reference:

1. R.G. Bartle, 2006 Elements of Real Analysis, John wiley and Sons.
2. A.L. Gupta and N.R. Gupta , 2003 Principles of Real Analysis, Pearson Education, (India Print) .
3. Richard R. Golberg, 2009 Methods of Real Analysis, Blaisdell Publishing Company.
4. S. Kesavan, 2019 Measure and Integration, TRIM.
5. S.C. Malik and Savita Arora, 2009 Mathematical Analysis, Second Edition, New Age International.
6. Paul Zorn , 2017, Understanding Real Analysis (2 edition) ,CRC Press.
7. Royden .H.L. 2009 – Real Analysis, PHI Learing Private .
8. Tom. M. Apostol, 2009 ,Calculus Volume 1,Wiley Student Edition, New Delhi.

E – Resources

1. **https://swayam.gov.in**
2. **www. epgpathsala.com.**
3. Vidya-mitra.inflibnet.ac.in
4. https://www.free-ebooks.net/mathematics - text books
5. http://math-forum.org,
6. http://ocw.mit.edu/ocw web/Mathematics,
7. http://www.opensource.org,
8. https://www.elsevier.com/mathematics

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**2**	**1**	**1**	**2**
CO 2	**3**	**2**	**2**	**1**	**1**	**2**
CO 3	**3**	**2**	**2**	**1**	**1**	**3**
CO 4	**3**	**2**	**2**	**1**	**1**	**2**
CO 5	**3**	**2**	**2**	**1**	**1**	**2**
Average	**3**	**2**	**2**	**1**	**1**	**2**

PEDAGOGY:

Chalk & Talk, Blended Learning, Screen sharing, Powerpoint presentation, Flipped learning, Encouraging Discussions, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

PROGRAMMING IN C++

TOTAL HOURS / WEEK: 6 **SUB CODE : 20PAMCT1003**
CREDIT: 4 **L, T, P : 4, 2, 0**

COURSE OBJECTIVES

1. The course provides an introduction to object-oriented programming using C++ language.
2. It provides the concepts such as data abstractions, classes, inheritance, method overloading and overriding, generic programming.
3. It enables the students to apply these features in program design and implementation.

COURSE OUTCOME:

On successful completion of the course the students will be able to

CO No.	CO Statement
CO1	List and use Object Oriented Programming concepts for problem solving.
CO2	Apply the concept of polymorphism to implement compile time polymorphism in programs by using overloading methods and operators.
CO3	Use the concept of inheritance to reduce the length of code and evaluate the usefulness.
CO4	Apply the concept of run time polymorphism by using virtual functions, overriding functions and abstract class in programs. .
CO5	Use I/O operations and file streams in programs. .

SYLLABUS

UNIT-I : **15 Hrs.**

Principles of Object-Oriented Programming (OOP)-Software evaluation-OOP Basic concepts of OOP-benefits of OOP-Applications of OOP.

UNIT –II : **15 Hrs.**

Introduction to C++ -Tokens-Keywords-Identifiers-Variables-Operators-Manipulators-Expressions and Control Structures-Pointers-Functions-Function Prototyping parameters passing in Functions-Values return by functions-Inline Functions-Friend and Virtual Functions.

UNIT-III : **15 Hrs.**

Classes and Objects-Constructors-Operator Overloading-Type Conversions-Type of Constructors-Function Overloading.

UNIT – IV : **15 Hrs.**

Inheritance-Types of Inheritance-Virtual Functions and Polymorphism Constructors in inheritance-Mapping Consol I/O operations.

UNIT –V : **15 Hrs.**

Files-File Operations- File Pointer-Error Handling during File operations- Command line arguments.

Text Books:

1. Balaguruswamy, (2011), Object Oriented Programming with C++ - 5th Edition, TMH.
2. Robert Lafore, (2001), Object Oriented Programming in Microsoft C++ - 4th Edition, Galgotia Publications.
3. Stanley B. Lippman, (2012), C++ Primer- 5thEdition, Addison-Wesley Professional.
4. Bjarne Stroustrup, (2013), The C++ Programming Language- 4th Edition, Addison – Wesley.
5. Andrew Koenig and Barbara E. Moo, (2000),C++:Practical Programming by Example – 5thEdition, Addison- Wesley Professional.

References:

1. Kyle Loudon, (2008) ,C++ complete Reference, O'Reilly Media, Inc
2. K.R Venugopal, Sudeep R Prasad (2017) - Mastering C, TMH.

Web Resources:

1. https://www.geeksforgeeks.org/cpp/
2. https://www.w3schools.com/cpp/
3. https://www.tutorialspoint.com/cplusplus/
4. https://www.cplusplus.com/doc/tutorial/
5. https://www.programiz.com/cpp-programming

PEDAGOGY:

Lecture -Black Board Teaching, Power Point Presentation, Exercises (Individual)

MAPPING: Course Outcome with Programme Specific Outcome

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	3	3	2	3	3	3
CO 2	3	1	2	2	2	3
CO 3	3	1	3	3	3	3
CO 4	3	2	1	2	2	3
CO 5	3	3	3	3	2	3
AVERAGE	3	2	2.2	2.6	2.4	3

COMPUTATIONAL LABORATORY I (C++ LAB)

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCP1001**
CREDIT: 4 **L-T-P: -,-,4**

COURSE OBJECTIVES

1. Define the concepts in Object Oriented Programming using C++.
2. To understand and analyze the special features of Object-Oriented Programming with C++.
3. To write C++ program for practical applications.

COURSE OUTCOMES: on completion of the course the students will be upgraded to…

CO No.	CO Statement
CO1	**Examine the basic concepts to know the basic OOPs concepts such as Class, Inheritance, Abstraction, Polymorphism & dynamic binding and ability to use data types, variables and arithmetic operators.**
CO2	**Interpret the teachings of function, Inline function, Friend function and to implement the program using functions.**
CO3	**Analyze the concept such as Constructors, Operator Overloading and Function Overloading**
CO4	**Explain to know about Inheritance, Virtual Functions, Polymorphism, Mapping Console I/O operations**
CO5	**Relate the File I/O, error handling during File operations and Command line Arguments and implement program using File concepts.**

List of Exercise **12 Hrs**

Simple Programs:

1. Generate the pyramid of digits
2. Generate Armstrong numbers upto a specific limit.
3. Generate Fibonacci series upto n (n<50) number

Functions

4.Construct a class for storage of dimensions circle, triangle and rectangle and calculate their areas.

Recursion

5. Print String backwards
6. Factorial of a numbers.

Polymorphism

7. Overload Unary operator
8. Overload Binary operator

Inheritance

9. Illustrate multilevel inheritance

Virtual and Friend Functions

10. Illustrate runtime polymorphism
11. Illustrate working of a friend function

File Handling in C++

12. Copy a text file to another

Templates

13. Illustrate a class template

Text Books:

1. Balaguruswamy, (2011), Object Oriented Programming with C++ - 5th Edition, TMH.
2. Robert Lafore, (2001), Object Oriented Programming in Microsoft C++ - 4th Edition, Galgotia Publications.
3. Stanley B. Lippman, (2012), C++ Primer- 5thEdition, Addison-Wesley Professional.
4. Bjarne Stroustrup, (2013), The C++ Programming Language- 4th Edition, Addison – Wesley.
5. Andrew Koenig and Barbara E. Moo, (2000), C++: Practical Programming by Example – 5thEdition, Addison- Wesley Professional.

References:

1. Kyle Loudon, (2008) ,C++ complete Reference, O'Reilly Media, Inc
2. K.R Venugopal, Sudeep R Prasad (2017) - Mastering C, TMH.

Web Resources:

1. https://www.geeksforgeeks.org/cpp/
2. https://www.w3schools.com/cpp/
3. https://www.tutorialspoint.com/cplusplus/
4. https://www.cplusplus.com/doc/tutorial/
5. https://www.programiz.com/cpp-programming

PEDAGOGY:

Lecture -Black Board Teaching, Power Point Presentation, Exercises (Individual)

MAPPING of CO with PSO:

CO/PSO	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	3	3	3	3
CO 2	3	1	2	3	3	3
CO 3	3	1	2	2	3	3
CO4	3	1	3	2	3	3
CO5	3	1	3	3	3	3
AVERAGE	3	1.2	2.6	2.6	3	3

PROBABILITY AND DISTRIBUTIONS

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMET1001**

CREDIT : 3 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES:

1. To develop formal treatment of probability and distributions.
2. To provide the knowledge in handling the multivariate random variables.
3. To acquire theoretical understanding of sampling distributions.

COURSE OUTCOMES: On completion of the course the students will be able to…

CO No.	CO Statement
CO1	Apply problem solving techniques using probability distributions to solve real world events
CO2	Handle the multiple random variables and solving the related problems in data analytics.
CO3	Describe the nature of multiple random variables in the analysis of bivariate distributions hence to design the appropriate models relevant to the study.
CO4	Demonstrate the knowledge in sampling distributions and apply its characteristics in sample studies.
CO5	Understand the behaviour of statistical convergence on the sequences of the random variables and using central limit theorem for convergence of non-normal distributions to normal distribution.

SYLLABUS

UNIT -I : **15 Hrs.**

Discrete Distributions – Negative Binomial, Geometric, Hyper-Geometric, Multinomial, (mgf, mean & variance of the above distributions). Continuous Distributions- Uniform, Normal, Gamma, Beta (mgf, mean & variance of the above distributions), Cauchy distribution.

Chapter-5 (Sections:5.2.5 to 5.2.6, 5.2.9, 5.3.1 to 5.3.5) --- Rohatgi

UNIT -II : **15 Hrs**.

Multiple random variables– independence - functions of several random variables– covariance, correlation and moments-conditional expectation**.**

Chapter-4 (Sections-4.1 to 4.6) (Theorems without proofs) --- Rohatgi

UNIT -III : **15 Hrs.**

Bivariate distributions – Bivariate binomial, bivariate poisson & Bivariate Normal distributions (mean & variance only)

Chapter-36 (Section-8) --- Johnson &Kotz

Chapter-37 (Section-2) --- Johnson &Kotz

Chapter-5 (Section-5.4)---Rohatgi

UNIT -IV : **15 Hrs**.

Exact Sampling Distributions - Chi-square statistic– definition, derivation of the pdf, mgf, additive property – independence of $\overline{X}$ &S^2 – t & F statistic – definition, derivation of the

pdf, mean and variance.
Chapter-7 (Sections-7.4&7.6) --- Rohatgi

UNIT -V : **15 Hrs.**

Modes of convergence - Convergence in probability & distribution,convergence almost surely, convergence in rth mean –Central limit theorem- Lindberg-Levy Central Limit Theorem.
Chapter-6(Sections-6.1,6.2 & 6.6) --- Rohatgi

Books for Study:

1.Vijay.K. Rohatgi, A.K. Md.Ehsanes Saleh,2017, An Introduction to Probability & Statistics, Second Edition, John Wiley & sons(Asia) Pte Ltd, Singapore.
2. Norman L. Johnson, Samuel Kotz, N.Balakrishnan, 2004, Discrete Multivariate Distributions, John Wiley & Sons (Asia) Pte Ltd, Singapore.

Books for Reference:

1.S.C.Gupta & V.K.Kapoor, Fundamentals of Mathematical Statistics,11 th edition, Sultan Chand&sons, 2014
2. E.J. Dudewicz and S.N. Mishra,1998, Modern Mathematical statistics.
3. S .S. Wilks, 2008,Mathematical Statistics, Princeton University press, Princeton, New Jersey.
4. P.R. Vittal,2002, Mathematical Statistics, Margham Publications.
5. Kapur.J.H. and Saxena .H.C. 1960,Mathematical Statistics,Sultan Chand & Co Ltd.
6. Norman L. Johnson, Samuel Kotz,2000,Continuous Multivariate Distributions, John Wiley & Sons (Asia) Pvt, Ltd., Singapore.
7. Robert V. Hogg & Allen T. Craig, 2002,Introduction to Mathematical Statistics, 5th Edition, Pearson Education, Singapore.
8.R. Bhattacharya and E.C.Waymire,2007, A Basic Course in Probability Theory, Springer .

E – Resources:

1. https://www.analyticsvidhya.com/blog/2017/09/6-probability-distributions-data-science/
2. http://www.utstat.toronto.edu/mikevans/jeffrosenthal/book.pdf
3. https://www.dcpehvpm.org/E-Content/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf
4. http://www.ru.ac.bd/stat/wp-content/uploads/sites/25/2019/03/501_06_Rohatgi_An-Introduction-to-Probability-and-Statistics-Wiley-2015.pdf
5. https://www.analyticsvidhya.com/blog/2017/09/6-probability-distributions-data-science/

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	3	2	2	3
CO 2	3	2	3	3	2	2
CO 3	3	3	2	2	2	3
CO 4	3	3	2	2	2	3
CO 5	2	2	1	1	1	3
Average	2.6	2.4	2.2	2	1.8	3.4

PEDAGOGY:

Chalk & Talk, Powerpoint presentation,Group Discussion,Seminar,Quiz through Google forms,Assignment through Online and Off line mode.

SEMESTER – II

S NO.	SUBJECT	PAPERS	TITLE OF THE PAPER	C	LH/W	CIA	ESE	T
1	CORE T IV	1	ALGEBRA II	4	6	40	60	100
2	CORE T V	1	TOPOLOGY	4	6	40	60	100
3	CORE T VI	1	PROGRAMMING IN JAVA	4	6	40	60	100
4	CORE P II)	1	COMPUTATIONAL LABORATORY II	4	4	40	60	100
5	ELECTIVE II	1	MATHEMATICAL STATISTICS	3	6	40	60	100
6	SOFT SKILL	1	SWAYAM (MOOC)	4	2	50	-	100
7	INTERNSHIP (as applicable)	1		2				100
		7		**25**	**30**			
TOTAL MARKS - MAJOR-400 ELECTIVE-100								

SEMESTER II

CORE PAPER IV- ALGEBRA-II

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT2004**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES:

1. To Orient the students to understand the concepts of algebra (linear transformation, matrix calculus , Jordan form) and to go abstract from concrete.
2. To understand the concept of Galois theory .
3. To gain knowledge in canonical forms and nilpotent transformation

COURSE OUTCOMES: On successful completion of the course the student will be able to

CO No.	CO Statement
CO1	Understand the concepts of Extension fields and transcendence of e.
CO2	Discuss algebra of linear transformations and characteristic roots.
CO3	Appreciate the significance of Galois theory.
CO4	Analyze canonical forms and nilpotent transformations.
CO5	Study the canonical forms and rational canonical forms .

SYLLABUS:

Unit-I: **15 Hrs.**

Extension Fields – Transcendence of e

Chapter 5: Sections 5.1 and 5.2.

Unit-II: **15 Hrs.**

Roots of Polynomials – More about roots.

Chapter 5: Sections 5.3 and 5.5.

Unit-III: **15 Hrs**.

Elements of Galois theory.

Chapter 5: Section 5.6.

Unit-IV: **15 Hrs.**

Linear Transformations: Canonical forms – nilpotent Transformations

Chapter 6: sections 6.4 and 6.5.

Unit-V: **15 Hrs.**

Jordan forms – Rational Canonical forms.

Chapter 6: sections 6.6 and 6.7.

Books for Study:

I.N. Herstein, 1975 Topics in Algebra (II Edition), John Wiley Eastern Limited, New Delhi.

Books for Reference

1.K. Hoffmann and R. Kunze , 2011,Linear Algrbra , 2nd Eddition , Person Education Taiwan Limited.

2. T.W. Hungerford,2000 , Algebra , Springer.

3. S.Kumaresan, 2000,Linear algebra, Prentice Hall.

4.Lang Serge ,2004, Linear Algebra-Addison Wesley.

5.Roo and Bhimsankaran , 2000, Linear Algebra , Hindustan book.

E – Resources:

1. https://math.illinoisstate.edu/gfseeli/fields.pdf
2. http://www.math.wsu.edu/students/jstreipel/notes/galoistheory.pdf
3. www. epgpathsala.com.
4. https://swayam.gov.in.
5. https://faculty.math.illinois.edu/~rotman/book.pdf

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	2	1	3
CO 2	3	3	2	1	2	2
CO 3	3	3	3	2	0	2
CO 4	3	3	3	3	2	2
CO 5	3	3	3	2	1	2
Average	3	3	2.6	2	1.2	2.2

PEDAGOGY:

Chalk & Talk, Powerpoint presentation,Group Discussion,Seminar,Quiz through Google forms,Assignment through Online and Off line mode.

CORE PAPER V - TOPOLOGY

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT2005**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES

1. To understand about continuous functions.
2. To provide for the students an introduction to theory of metric and topological spaces Compact , Connected Spaces and Hausdorff spaces.
3. To learn about Separation Axioms.

COURSE OUTCOMES: On successful completion of the course the student will be able to

CO No.	CO Statement
CO1	Solve variety of examples and counterexamples of a function which is defined on metric spaces,and identify the set of points on which a function is continuous.
CO2	Generate a topology from collection of subsets , basis for a topology, know the definitions of standard terms in topology , construct various topologies on a general set by using different kinds of techniques
CO3	Construct the product topology on the cartesian product of topological spaces by using given two or more topological spaces. Compact space and discus their relation in general topological spaces and metric spaces in particular.
CO4	Categorize the separation axioms which separate a point from another point, a point from a set that does not contain this point and a set from another set. Express T-1, T-2, T-3 separation axioms, regularity and normality separation axioms and use them to prove various properties.
CO5	Introduce Connected spaces,Totally disconnected spaces and their properties.

SYLLABUS:

Unit-I: **15 Hrs.**

Metric Spaces: Convergence, completeness and Baire's theorem- Continuous mappings-Spaces of Continuous functions- Euclidean and Unitary spaces.Topological Spaces: The definition and some examples-elementary concepts.

Chapter 2: Sections: 12 – 15

Chapter 3: Sections: 16 & 17

Unit-II: **15 Hrs.**

Topological spaces (contd…): Open bases and sub bases.Compactness: Compact spaces, Product of spaces. Chapter 3: Section: 18

Chapter 4 : Sections: 21 & 22

Unit-III: **15 Hrs.**

Tychonoff's theorem and locally compact spaces- compactness for metric spaces- Ascoli's theorem. Chapter 4 : Sections : 23 – 25

Unit-IV: **15 Hrs.**

T1 – spaces and Hausdorff spaces- completely regular spaces and normal spaces- Urysohn's lemma and Tietze extension theorem.

Chapter 5 : Sections: 26 – 28

Unit-V: **15 Hrs.**

Connected spaces- The components of a space- Totally disconnected spaces - Locally connected spaces.Chapter 6 : Sections: 31 – 34

Books for Study

1.George F.Simmons,1963, Reprint 1983 ,Introduction to Topology and Modern Analysis, McGraw Hil Book Co.(Treatment and Content)

2.James R. Munkres,2002, (Third Indian Reprint) Topology (2nd edition) Pearson Education Pvt Ltd., Delhi .

Books for Reference

1. J. Dugundji , 1975 ,Topology, Prentice Hall of India, New Delhi.
2. J.L. Kelly, General Topology , Van Nosttand, Reinhold Co., New york.
3. S.Willard, 1970 ,General Topology, Addison – Wesley , Mass.,.

E – Resources

1. https://swayam.gov.in
2. www. epgpathsala.com.
3. Vidya-mitra.inflibnet.ac.in
4. http://mathworld.wolfram.com
5. http://mathonline.wikidot.com/bases-of-a-topology
6. https://www.sciencedirect.com/science/article/pii/S0166864112003331

7.https://faculty.etsu.edu/gardnerr/5357/notes/Munkres-Chapter4-intro.pdf

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	2	1	1	3
CO 2	3	2	2	1	1	3
CO 3	3	2	2	1	1	3
CO 4	3	2	2	1	1	3
CO 5	3	2	2	1	1	3
Average	3	2	2	1	1	3

PEDAGOGY:

Chalk & Talk, Blended Learning, Screen sharing, Powerpoint presentation, Flipped learning, Encouraging Discussions, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

PROGRAMMING IN JAVA

TOTAL HOURS/WEEK: 6 **SUB CODE: 20PAMCT2006**
CREDIT: 4 **L-T-P: 4,2,0**

COURSE OBJECTIVES

1. Understanding the fundamentals of Java.
2. Gain knowledge about Object oriented concepts, Packages and Threads
3. Design Applet and AWT classes and controls.

COURSE OUTCOME:

On successful completion of the course the students will be able to

CO NO	CO Statement
CO1	Knowledge of the structure and model of the Java programming language, (knowledge).
CO2	To apply logical constructs for branching and loops as well as use iterator objects when appropriate.
CO3	Identify classes, objects, members of a class and relationships among them needed for a specific problem .
CO4	Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements and learn the basics of polymorphism through use of super-classes and interfaces.
CO5	Familiar with the use of input, output, and object stream objects and to use such streams for file processing as well as client/server communications tasks.

SYLLABUS

UNIT – I: 15 Hrs.

Introduction to Java-Features of Java-Object Oriented Concepts-Lexical Issues-data Types-Variables-Arrays-Operators -Control Statements.

UNIT – II: 15 Hrs.

Class- Objects-Constructors-Overloading method-Access Control -Static and fixed methods-Inner Classes-String Class-Inheritance-Overriding methods -Using Super Abstract class.

UNIT – III : 15 Hrs.

Packages-Access protection- Importing. Packages -Interfaces -Exception Handling-Throw and Throws.

UNIT – IV : 15 Hrs.

Thread-Synchronization-Messaging-Runnable Interface-Interthread Communication-Deadlock-Suspending, Resuming and stopping threads-Multithreading.

UNIT- V : 15 Hrs.

I/O Streams-File Streams-Applets- String Objects-String Buffer- Char Array -Java Utilities-Code Documentation

Text Books:

1. E. Balaguruswamy, (2010), Programming with Java- A Primer- (4th Edition) TMH.
2. Cay s. Horstman, Gary Cornell, (2000), Core Java 2 Volume 1- Fundamentals, (5th Edition) PHI.
3. Naughton and H. Schildt, (2001), Java2 - The Complete Reference- 4thEdition, Osborne Publishing.
4. Herbert Schildt, (2017), Java Complete Reference- 7thEdition, TMH.
5. Krishna Rungta, (2016), Java Programming for Beginners Guide Kindle Edition, Guru99.

References:

1. E. Balaguruswamy, (2010), Programming with Java- A Primer- (4th Edition) TMH.
2. Xavier, (2004), CProgramming with Java 2,Scitech Publication.
3. K. ArnoldandJ. Gosling, (2000), the Java Programming Language- 3rd Edition, Addison Wesley.

Web Resources:

1. https://www.geeksforgeeks.org/cpp/
2. https://www.w3schools.com/cpp/
3. https://www.tutorialspoint.com/cplusplus/

PEDAGOGY:

Lecture -Black Board Teaching, Power Point Presentation, Exercises (Individual)

MAPPING: Course Outcome with Programme Specific Outcome

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	3	3	3	3	3	3
CO 2	3	2	2	3	3	3
CO 3	3	3	3	2	3	3
CO 4	3	3	2	3	3	3
CO 5	3	2	3	3	3	3
AVERAGE	3	2.6	2.6	2.8	3	3

COMPUTATIONAL LABORATORY II (JAVA LAB)

TOTAL HOURS / WEEK: 4 **SUB CODE: 20PAMCP2002**

CREDIT : 4 **L,T, P : - , -, 4**

COURSE OBJECTIVES

1. Programming in the Java programming language.
2. Knowledge of object-oriented paradigm in the Java programming Language.
3. The use of Java in a variety of technologies and on different platform

COURSE OUTCOMES: on completion of the course the students will be able to…

CO No.	CO Statement
CO1	Able to apply OOP in problem solving and develop basic programs.
CO2	Able to develop basic programs on multithreading and exception handling
CO3	Able to implement code for accessing the information from files
CO4	Able to implement code thread synchronization and Vector classes.
CO5	Able to create GUI based applications using swings and applets

Applications: **12Hrs.**

1.Substring Removal from a String. Use String Buffer class.

2.Finding area and Perimeter of a circle. Use Buffered Reader class

3.Determining the order of numbers generated randomly using Random class.

4.Implementation of Point Class for Image manipulation.

5.String Manipulation using Char Array.

6.Usage of Vector Class

7.Implementing Thread based applications & Exception Handling.

8.Application using synchronization such as Thread based, Class based and synchronized statements.

Applets:

9. Working with Frames and various controls.
10. Working with Dialogs and Menus.
11. Working with Panel and Layout.
12. Working with Colors and Fonts.

Text Books:

1. E. Balaguruswamy, (2010), Programming with Java- A Primer- (4th Edition) TMH.
2. Cay s. Horstman, Gary Cornell, (2000), Core Java 2 Volume 1- Fundamentals, (5th Edition) PHI.
3. Naughton and H. Schildt, (1999), Java2 - The Complete Reference -3rd Edition, Osborne Publishing.
4. Herbert Schildt, (2017), Java Complete Reference- 7thEdition, TMH.
5. Krishna Rungta, (2016), Java Programming for Beginners Guide Kindle Edition, Guru99.

References:

1. E. Balaguruswamy, (2010), Programming with Java- A Primer- (4th Edition) TMH.
2. Xavier, (2004), CProgramming with Java 2,Scitech Publication.
3. K. ArnoldandJ. Gosling, (2000), The Java Programming Language- 3rdEdition, Addison Wesley

Web Resources:

1. https://www.geeksforgeeks.org/cpp/
2. https://www.w3schools.com/cpp/
3. https://www.tutorialspoint.com/cplusplus/

PEDAGOGY:

Lecture -Black Board Teaching, Power Point Presentation, Exercises (Individual)

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	2	3	3	3
CO2	3	2	3	3	3	3
CO3	3	3	3	3	2	2
CO4	3	2	2	3	3	3
CO5	3	3	2	2	3	2
Average	3	2.6	2.4	2.8	2.8	2.6

MATHEMATICAL STATISTICS

TOTAL HOURS / WEEK: 6 **SUB CODE:20PAMET2002**

CREDIT : 3 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES

1. Provide the foundation of statistical methods to analyse relevant data.
2. Understand the concepts of statistical analysis used in various fields of engineering and sciences like disease modeling, climate prediction and computer networks ect…
3. Learn the basic concepts of parameter estimation and testing.

COURSE OUTCOMES: On completion of the course the students will be able to…

CO No.	CO Statement
CO1	Analyse the characteristics of the parameters of interest.
CO2	Apply the knowledge of estimating the desired information about the parameters by suitable methods from the received data.
CO3	Gain the theoretical knowledge of the proposed methodology in hypothesis testing which guaranteeing the optimal detection.
CO4	Design hypothesis performed on a sample data and apply the desired concept to find inferences about population parameter.
CO5	Handle in taking decisions of sample data if there is two or more groups are significantly different to identify issues between the samples.

SYLLABUS

UNIT -I : **15 Hrs.**

Point Estimation - Consistency, sufficiency and completeness, Factorization Criterion, Unbiasedness, MVUE, LMVUE, UMVUE– Rao-Blackwell theorem Lehman- Scheffe theorem Cramer-Rao inequality , Chapman-Robin's inequality.
Chapter-8(Sections-8.1 to 8.5)

UNIT -II : **15 Hrs.**

Point Estimation(contd.)- Methods of estimation - method of moments, MLE.
Confidence Estimation - shortest length confidence interval – Confidence intervals for the parameters of normal distribution.
Chapter-8(Sections-8.6& 8.7)
Chapter-11 (Sections-11.1 ,11.2& 11.4)

UNIT -III : **15 Hrs.**

Testing of Hypothesis - Errors in hypothesis testing – Neyman-Pearson lemma – Most powerful tests- Families with MLR– unbiased and invariant tests.
Chapter-9 (Sections-9.1 to 9.5)

UNIT-IV: **15 Hrs.**

Generalized Likelihood ratio test – definition, LRT for Binomial, LRT for Normal(one and two populations only) -Tests Of Significance - Chi-Square($\chi 2$), t and F tests.
Chapter-10 (Sections-10.1 to 10.5)

UNIT -V: **15 Hrs.**

ANOVA – one-way ANOVA, two-way ANOVA with one observation per Cell. (Rohatgi)
Simple linear regression model – Estimation of the parameters, Testing the significance and analysis of variance of regression. (Montgomery)
Chapter-12 (Sections- 12.4 and 12.5) (Rohatgi)
Chapter-2(Sections-2.1 to 2.3) (Montgomery)

Books for Study:

1.Vijay.K. Rohatgi, A.K.Md.Ehsanes Saleh, 2017,An Introduction to Probability & Statistics, Second Edition, John Wiley & sons(Asia) Pte Ltd,Singapore.
2.Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining,2014, Introduction to Linear Regression Analysis, Third Edition, Wiley India Pvt. Ltd, New Delhi.

Books for Reference:

1.S.C.Gupta&V.K.Kapoor, 2014, Fundamentals of Mathematical Statistics,11 th edition, Sultan Chand &sons, .
2.E.J. Dudewicz and S.N. Mishra, 1988, Modern Mathematical statistics, John Wiley & sons, New York.
3.S.S. Wilks, 2008,Mathematical Statistics, Princeton University Press, Princeton, New Jersey.
4.P.R. Vittal, 2002,Mathematical Statistics, Margham Publications.
5.Kapur. J.H. and Saxena .H.C. 1960,Mathematical Statistics, Sultan Chand & Co Ltd.
6.Norman R. Draper, Harry Smit,2011, Applied Regression Analysis, 2nd edition.
7. Robert V. Hogg & Allen T. Craig, 2002,Introduction to Mathematical Statistics, 5th Edition, Pearson Education, Singapore.
8.R. Bhattacharya and E.C.Waymire, 2007,A Basic Course in Probability Theory, Springer.

E – Resources:

1. https://en.wikipedia.org/wiki/Simple_linear_regression
2. https://towardsdatascience.com/simple-linear-regression-model-using-python-machine-learning-eab7924d18b4
3. https://www.youtube.com/watch?v=TKkKuZdcLGk
4. https://www.pitt.edu/~super1/ResearchMethods/Arabic/HypothesisTestingpart1.pdf
5. https://www.khanacademy.org/math/statistics-probability/significance-tests-one-sample/more-significance-testing-videos/v/hypothesis-testing-and-p-values

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**2**	**1**	**2**	**1**	**1**	**3**
CO 2	**3**	**2**	**3**	**2**	**2**	**3**
CO 3	**2**	**1**	**2**	**1**	**1**	**3**
CO 4	**3**	**2**	**3**	**2**	**2**	**3**
CO 5	**2**	**3**	**3**	**2**	**2**	**3**
Average	**2.4**	**1.8**	**2.6**	**1.6**	**1.6**	**3**

PEDAGOGY:

Chalk & Talk, Power point presentation, Group Discussion, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

SEMESTER III

S NO.	SUBJECT	PAPERS	TITLE OF THE PAPER	C	LH/ W	CIA	ESE	T
1	CORE T VII	1	COMPLEX ANALYSIS	4	6	40	60	100
2	CORE T VIII	1	DIFFERENTIAL EQUATIONS	4	6	40	60	100
3	CORE T IX	1	CLASSICAL MECHANICS	4	6	40	60	100
4	ELECTIVE III	1	PYTHON PROGRAMMING	3	4	40	60	100
5	CORE P III	1	COMPUTATIONAL LABORATORY III	4	6	40	60	100
6	SOFT SKILL	1	RESEARCH SKILLS	3	2	50	-	100
		6		**22**	**30**			
TOTAL MARKS - MAJOR-400 ELECTIVE-100								

SEMESTER III

COMPLEX ANALYSIS PAPER VII

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT3007**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES

1. To enable the Students to understand the concepts of Analytic functions, the theory of entire functions, Expose to general form of Cauchy's theorem
2. Understand properties of Harmonic functions on a disc and concerned results.
3. Introduce series and product developments.

COURSE OUTCOMES:

CO No.	CO Statement
CO1	Analyze analytic functions in a punctured disk, behaviour of analytic function ,Index of a closed curve, Genus and order of an entire function, Generalizations of harmonic functions to solve the Dirichlet problem.
CO2	Classify Singularities, Represent functions as Laurent series, identify isolated singularities using Laurent Expansion, evaluate complex integrals using the residue theorem and apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.
CO3	Investigate Range of an analytic function, some results about the range of an analytic function,. Explain Hadamard Factorization theorem.
CO4	Apply Schwarz's lemma, Weierstrass Factorization theorem, Gamma function.
CO5	Demonstrate a relationship between Zeta function and the Gamma function. Deduce Jensen's formula.

SYLLABUS:

Unit-I: **15 Hrs.**

Complex integration: Zeros of an analytic function- the index of a closed curve – Cauchy's theorem and integral formula – the homotopic version of Cauchy's Theorem and simple connectivity – Counting zeros & open mapping theorem – Goursat's theorem.

Chapter 4 : Section 3 to 8

Unit-II: **15 Hrs.**

Singularities: Classification of Singularities –residues-the Argument principle.
The Maximum Modulus theorem : The Maximum Principle – Schwarz 's lemma
Chapter 5: Section 1 to 3
Chapter 6: Section 1 and 2

Unit-III: **15 Hrs.**

Compactness and convergence in the space of analytic functions:
The Riemann mapping theorem – Weierstrass Factorization theorem – Factorization of the sine function - The gamma function -The Riemann – zeta function.
Chapter 7: Section 4 to 8

Unit-IV: **15 Hrs.**

Harmonic functions : Basic properties of Harmonic function – Harmonic functions on a disk- Subharmonic and superharmonic function – The Dirichlet problem – Green's functions
Chapter 10 : Section 1 to 5

Unit-V: **15 Hrs.**

Entire Functions: Jensens formula – The genus and order of an entire function – Hadamard Factorization theorem.
The Range of an Analytic function: Bloch's theorem –The Little Picard theorem – Schottky's theorem .
Chapter 11 : Section 1 to 3
Chapter 12 : Section 1 to 3

Books for Study:

John B. Conway , 2002, Functions of one complex variable, springer – Verlag,international student edition, Narosa publishing co.,Revised Edition.

Books for Reference:

1. Lars V. Ahlfors, 1979,Complex Analysis, (3rd edition) McGraw Hill Co., New York.
2. E.Hille, 1959,Analytic function Theory (2 vols), Gonm& co,.
3. M.Heins, 1968, Complex function Theory, Academic press, New York.
4. T.W. Gamelin, 2001, Complex Analysis, Springer-Verlag.
5. S. Ponnusamy and H. Silverman, 2006, 524 pp ,Complex Variables with Applications, Birkhaeuser, Boston.
6. H.A.Prestly,1990, Introduction to complex Analysis,Clarendon Press Oxford .

E – Resources

1. https://swayam.gov.in
2. www. epgpathsala.com.
3. Vidya-mitra.inflibnet.ac.in
4. Websites and e- learning sources http//mathforum.org
5. http//www.mathfaculty.fullerton.edu

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	2	1	1	3
CO 2	3	2	2	1	1	3
CO 3	3	2	2	1	1	3
CO 4	3	2	2	1	1	2
CO 5	3	2	2	1	1	2
Average	3	2	2	1	1	2.6

PEDAGOGY:

Chalk & Talk, Blended Learning, Screen sharing, Powerpoint presentation, Flipped learning, Encouraging Discussions, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

CORE PAPER VIII-DIFFERENTIAL EQUATIONS

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT3008**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES

1. To learn different methods to solve higher order differential equations.
2. Understand the concepts of differential equations used in various fields of engineering and sciences.
3. To analyse the models and methods of partial differential equations in field of research.

COURSE OUTCOMES: on completion of the course the students will be able to…

CO No.	CO Statement
CO1	To study the method of solving Bessel's and Legendre differential equations.
CO2	Students will be able to solve homogeneous and non-homogeneous linear system of differential equations with constant coefficients.
CO3	Students will acquire through understanding on the approximate analytic method through iterative method.
CO4	Identify the physical situation formulate mathematical models and using Partial differential equations.
CO5	Apply the acquired knowledge to select the most appropriate method to solve particular Partial differential equations.

SYLLABUS:

Unit-I : **15 Hrs.**

Solutions in Power Series: Introduction – Second order Linear equations with ordinary points, Legendre equation and Legendre polynomials- Second order equation with Regular singular point – Properties of Bessel functions

Chapter 3: Sections: 3.1 - 3.5

Unit-II: **15 Hrs.**

Systems of Linear Differential Equations: Introduction – Systems of first order equations – Model for arms competition between two nations-Existence and uniqueness theorem Fundamental matrix – Non-homogeneous linear systems – Linear systems with constant Coefficients

Chapter 4 :Sections: 4.1 - 4.7

Unit-III: **15 Hrs.**

Existence and uniqueness of solutions: Introduction – Preliminaries – Successive approximations – Picard's theorem – Some examples.

Chapter 5 :Sections: 5.1 - 5.5

Unit-IV: **15 Hrs.**

First order Partial Differential Equations: Introduction – Partial differential equations of first order in two independent variables – Formulation of first order partial differential equations – Solution of linear first order partial differential equations (Lagrange's method) – Integral surfaces passing through a given curve surfaces orthogonal to a given system of surfaces – Compatibility of first order partial differential equations – Classification of the solution of first order partial differential equations – solution to Non-linear partial differential equations of first order – Charpit's method – Jacobi's method .

Chapter 1 Sections: 1.1 - 1.9

Unit-V: **15 Hrs.**

Second order Partial Differential Equations: Origin of second order partial differential equations - Linear partial differential equations with constant coefficients – Method of solving linear partial differential equations – Solution of reducible equations – Solution of irreducible equations with constant coefficients – Rules for finding complementary functions – Rules for finding particular integrals –classification of second order partial differential equations – Canonical forms.

Chapter 2: Sections: 2.1 - 2.5

Books for study:

For Unit 1, Unit 2 and Unit 3 S.G. Deo, S.D. Lakshmikanthan and V. Raghavendra, Fourth Reprint 2003, Ordinary Differential Equations, Second Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.

For unit 4 and Unit 5 J.N .Sharma and Keharsingh, Copyright 2000, 2009, First reprint 2001, Second edition 2009 Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, NewDelhi, 2000.

Books for Reference:

1. Earl A, 2012,An Introduction to Ordinary Differential Equations, Earl A, Coddington Prentice-Hall.
2. Edward L. Ince, 2012,Ordinary Differential Equations, Dover Publication, New York.
3. Harry Pollard,2012, Ordinary Differential Equations, Dover Publication, New York.
4. M.D.Raisinghania, 2001,Ordinary and Partial Differential Equations, S.Chand & Company Ltd,New Delhi.
5. Refaat EI Attar,2006, Ordinary Differential Equations, LULU Press incorporated Morrisville USA.
6. Wolfgang Walter, 2013,Ordinary Differential Equations, Springer Verlag, Newyork.

E – Resources:

1. https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/lecture-7-first-order-linear-with-constant-coefficients/
2. http://www.scholarpedia.org/article/Partial_differential_equation#First-Order_Partial_Differential_Equations
3. https://youtu.be/CFglFzii7FY
4. https://youtu.be/oL97oGZUINA
5. https://youtu.be/rHgaA8QG9c4

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	2	1	2
CO 2	3	1	3	1	2	2
CO 3	3	1	1	2	2	2
CO 4	3	2	2	3	1	2
CO 5	3	2	2	3	1	2
Average	3	1.6	2.2	2.2	1.4	2

PEDAGOGY:

Chalk & Talk, Powerpoint presentation,Group Discussion,Seminar,Quiz through Google forms,Assignment through Online and Off line mode.

CORE PAPER IX - CLASSICAL MECHANICS

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT3009**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES

1. The learner will become proficient in the concepts of mechanics and gain deeper understanding of advance skills and capability for formulating and solving problems.
2. Increase mathematical and computational knowledge.
3. Students develop capabilities in order to obtain solutions to problems, too difficult or impossible to solve it a analytically.

COURSE OUTCOMES:

on completion of the course the students will be able to…

CO No.	CO Statement
CO1	Gain a detailed knowledge about the mechanical system of particles.
CO2	Analyze and evaluate the derivation of Lagrange's Equations from Hamilton's Principle and Extension of Hamilton's Principle to Non-holonomic Systems.
CO3	Understand the concept of rigid body, Euler angles and the Corolis force.
CO4	Analyze the concept of the Hamilton Equations of Motion and the Principle of Least Action.
CO5	Understand and apply into practical problems

SYLLABUS

Unit– I: **15Hrs.**

Mechanics of a particle-Mechanics of a system of particles-Constraints-D'Alembert's principle and Lagrange's equation-simple applications of the Lagrangian formulation.

Chapter 1: Sections 1.1-1.4, 1.6 (omit 1.5)

Unit– II: **15Hrs.**

Hamilton's principle-Some techniques of the calculus of variations-Derivation of Lagrange's equation from Hamilton's principle-Extension of Hamilton's principle to Nonholonomic systems-Conservation theorems and symmetry properties.

Chapter2: Sections 2.1-2.4, 2.6 (omit 2.5)

Unit– III: **15Hrs.**

The independent coordinates of a rigid body-The Euler angles-Euler's theorem on the motion of a rigid body-Rate of change of a vector-The Coriolis force.

Chapter 4: Sections 4.1, 4.4, 4.6, 4.9, 4.10

Unit– IV: **15 Hrs.**

Angular momentum and Kinetic energy of motion about a point-Tensor and dyadics-The inertia tensor and the moment of inertia-The eigen values of the inertia tensor and the principal axis transformation-Methods of solving rigid body problems and the Euler equations of motion- Legendre transformations and the Hamilton equations of motion- Routh's procedure and oscillations about steady motion.
Chapter 5: Sections 5.1-5.5
Chapter 8: Sections 8.1, 8.3

Unit– V: **15 Hrs.**

The principle of least action-The equations of canonical transformation-Examples of canonical transformations-The symplectic approach to canonical transformations-Poission brackets and other canonical invariants.
Chapter 8 :Section 8.6
Chapter 9: Sections 9.1-9.4

Books for Study:

Herbert Goldstein , Classical Mechanic,1986, Reprint 2001,II Edition ,Narosa Publishing House New Delhi.

Books for Reference:

1. P.Chorlton,Van Nostrand, Text Book of Dynamics.
2. Donald T.Greenwood ,1988, Principles of Dynamics,II Edition Prentice Hall of India Private Limited, New Delhi.
3. David Morin ,2008,Introduction to classical mechanics ,Cambridge Press .
4. Rajneesh Goel Anmol ,Classical Mechanics ,2014 Publication Pvt. Limited First edition .
5. D.E.Rutherford, 1988,Classical Mechanics,Olover Boyd.
6. Sankara Rao K, 2011, Classical mechanics Phi learning Pvt Ltd.
7. Principles of Mechanics-J.L.Synge and B.A.Griffith, 1970,Principles of Mechanics,III Edition McGraw Hill Book House, New York.

E – Resources:

1. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
2. https://sites.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf
3. https://iopscience.iop.org/book/978-0-7503-1398-8
4. http://www.freebookcentre.net/physics-books-download/Classical-Mechanics-Lecture-Notes-[PDF-8p].html
5. https://www.cmi.ac.in/~govind/teaching/cm2-e16/cm2-lecture-notes-gk-2016.pdf

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**3**	**2**	**2**	**2**
CO 2	**3**	**3**	**3**	**2**	**1**	**1**
CO 3	**3**	**3**	**3**	**1**	**0**	**1**
CO 4	**3**	**2**	**3**	**1**	**1**	**2**
CO 5	**3**	**3**	**3**	**3**	**1**	**2**
Average	**3**	**2.8**	**3**	**1.8**	**1**	**1.6**

PEDAGOGY:

Chalk & Talk, Powerpoint presentation,Group Discussion,Seminar,Quiz through Google forms,Assignment through Online and Off line mode.

ELECTIVE III PYTHON PROGRAMMING

TOTALHOURS/ WEEK:6 **SUB CODE: 20PAMET3003**
CREDIT: 3 **L-T-P: 4-2-0**

COURSE OBJECTIVES

1. Learn Syntax and Semantics and create Functions in Python.
2. Handle Strings and Files in Python and understand Lists, Dictionaries and Regular expressions in Python.
3. Implement Object Oriented Programming concepts in Python and Database Programming in Python

COURSE OUTCOMES:

On completion of the course the students will be able to…

CO No.	CO Statement
CO1	Examine Python syntax and semantics and be fluent in the use of Python flow control and function
CO2	Demonstrate proficiency in handling Strings and File Systems.
CO3	Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
CO4	Interpret the concepts of Object-Oriented Programming as used in Python.
CO5	Implement exemplary applications related to Databases in Python.

SYLLABUS

UNIT – I: **15 Hrs**.

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT– II: **15 Hrs**.

Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass

UNIT– III: **15 Hrs.**

Data Structures: Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.

UNIT– IV: **15 Hrs.**

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing.

UNIT– V: **15 Hrs.**

Database Programming: Introduction, Python Database Application Programmer's Interface (DB-API), Object Relational Managers (ORMs), Related Modules.

Text Books:

1. Allen B. Downey, (2016), ``Think Python: How to Think Like a Computer Scientist''- 1st Edition updated for Python 3, Shroff/O'Reilly Publishers.
2. Vamsi Kurama,(2017), Python Programming: A Modern Approach, Pearson Education.
3. Mark Lutz, (2013),Learning Python - 5thEdition, O'Reilly.
4. Wesley J. Chun, (2006), Core Python Programming -2nd Edition, Prentice Hall.
5. Brian Draper, (2016), Python Programming, Create Space Independent Publishing Platform.

Reference:

1Allen B. Downey, (2016), ``Think Python: How to Think Like a Computer Scientist''- 1st Edition updated for Python 3, Shroff/O'Reilly Publishers.
2. Wesley J. Chun, (2006), Core Python Programming -2nd Edition, Prentice Hall.
3. Kenneth A. Lambert, Cengage, (2011), Introduction to Python, South – Western College

WebResources:

1. www.udemy.com/Python/Online-Course
2. http://greenteapress.com/wp/think- python➢ Read and write data from/to files
3. Python. https://docs.python.org/3/tutorial/
4. https://beginnersbook.com/2018/01/introduction-to-python-programming
5. https://www.afternerd.com/blog/difference-between-list-tuple

PEDAGOGY (TEACHING METHODOLOGY):

Method adopted for instructional hours to be mentioned.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	2	3	3
CO2	3	2	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	2	2	3
CO5	3	3	3	3	2	3
Average	3	2.6	3	2.6	2.6	3

COMPUTATIONAL LABORATORY III (PYTHON LAB)

TOTALHOURS/ WEEK:4 **SUB CODE: 20PAMCP3003**

COURSE OBJECTIVES

1. Ability to analyze and develop computer programming skills towards Development of Innovative Applications.
2. Ability to apply standard practices and strategies in software project development using software tools to excel as an Entrepreneur.
3. Create, select, and apply appropriate techniques, resources, and modern IT tools with an understanding of the limitations.

COURSE OUTCOMES: on completion of the course the students will be able to…

CO No.	CO Statement
CO1	Student should be able to understand the basic concepts scripting and the contributions of scripting language.
CO2	Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.
CO3	Identify the external modules and import specific methods from them.
CO4	Demonstrate proficiency in handling Strings and File Systems.
CO5	Ability to explore python especially the object-oriented concepts, and the built-in objects of Python

Applications: **12 Hrs.**

1. Write a Python program to find all prime numbers within a given range.
2. Write a Python program to print ‘n terms of Fibonacci series using iteration.
3. Write a Python program to find GCD of two numbers.
4. Write a Python Program to find the square root of a number by Newton’s Method.
5. Write a Python program to find the exponentiation of a number.
6. Write a Python Program to find the maximum from a list of numbers.
7. Write a python Program to read a number and display corresponding day using if_elif_else
8. Write a Python program to multiply matrices.
9. Write a Python program to get a string from a given string where all occurrences of its first char have been changed to '$', except the first char itself
10. Create a list and perform the following methods 1) insert () 2) remove () 3) append () 4) Len () 5) pop () 6) clear ()
11. Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get () 4)change values 5) use Len()
12. Write a python program which accepts the radius of a circle from user and computes the area (use math module).
13. Write a python program to perform various database operations (create, insert, delete, update).

Text Books:

1. Allen B. Downey, (2016), ``Think Python: How to Think Like a Computer Scientist''- 1st Edition updated for Python 3, Shroff/O'Reilly Publishers.
2. Vamsi Kurama, (2017), Python Programming: A Modern Approach, Pearson Education.
3. Mark Lutz, (2013), Learning Python - 5th Edition, O'Reilly.
4. Wesley J. Chun, (2006), Core Python Programming -2nd Edition, Prentice Hall.
5. Brian Draper, (2016), Python Programming, Create Space Independent Publishing Platform.

Reference:

1Allen B. Downey, (2016), ``Think Python: How to Think Like a Computer Scientist''- 1st Edition updated for Python 3, Shroff/O'Reilly Publishers.
2. Wesley J. Chun, (2006), Core Python Programming -2nd Edition, Prentice Hall.
3. Kenneth A. Lambert, Cengage, (2011), Introduction to Python, South – Western College

Web Resources:

1. www.udemy.com/Python/Online-Course
2. http://greenteapress.com/wp/think- python
3. https://docs.python.org/3/tutorial/
4. https://beginnersbook.com/2018/01/introduction-to-python-programming/
5. https://www.afternerd.com/blog/difference-between-list-tuple

PEDAGOGY:

Lecture -Black Board Teaching, Power Point Presentation, Exercises (Individual)

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	3	3
CO2	3	3	3	2	3	3
CO3	3	2	3	3	3	3
CO4	3	3	3	2	3	3
CO5	3	3	3	2	3	3
Average	3	2.8	3	2.2	3	3

SEMESTER IV

S NO.	SUBJECT	PAPERS	TITLE OF THE PAPER	C	LH/W	CIA	ESE	T
1	CORE T X	1	Functional Analysis	4	6	40	60	100
2	CORE T XI	1	Differential Geometry and Tensor Calculus	4	6	40	60	100
3	ELECTIVE IV	1	Calculus of Variations and Integral Equations	3	6	40	60	100
4	CORE PROJECT	1	PROJECT	4	4	40	60	100
5	ELECTIVE V	1	Operations Research	3	6	40	60	100
6	SOFT SKILL	1	SWAYAM (MOOC)	4	2	50	-	100
		6		**22**	**30**			
TOTAL MARKS - MAJOR-300 ELECTIVE-200								

CORE PAPER X -FUNCTIONAL ANALYSIS

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT4010**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES

1.This course is intended to make the students understand and gain the concepts of functional analysis and their role in modern mathematics

2.Develop the capacity for mathematical reasoning through ork zing, proving and explaining concepts from functional analysis.

3. Ability to apply knowledge of functional analysis, to solve mathematical problems.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO No.	CO Statement
CO1	Understand the concepts of Banach spaces and Hilbert spaces and learn to classify with standard examples. In particular, spaces of sequences and functions.
CO2	Study the three structure theorems of Functional Analysis viz., Hahn Banach Theorem, Open mapping theorem and Uniform Boundedness principle. And understanding the applications of three structure theorems of Functional Analysis.
CO3	Understand and Analyze results in the theory with accuracy and proper formalism.
CO4	Understand the concepts of relevance Operator Theory and discuss Determinants and the spectrum of an operator
CO5	Analyze and apply the concepts and applications of Banach Algebra.

SYLLABUS

UNIT– I: **15 Hrs.**

Banach Spaces : Definition – Some examples – Continuous Linear Transformations – The Hahn-Banach Theorem – The natural embedding of N in N**.
Chapter 9 : Sections 46 to 49.

UNIT– II: **15 Hrs.**

Banach Spaces and Hilbert Spaces : Open mapping theorem – Conjugate of an operator - Definition and some simple properties.Orthogonal complements – Orthonormal sets.
Chapter 9 : Sections 50 and 51
Chapter 10 : Sections 52, 53 and 54

UNIT– III: **15 Hrs.**

Hilbert Space : Conjugate space H* - Adjoint of an operator – Self-adjoint operator – Normal and Unitary operators.
Chapter 10 : Sections 55, 56 57 and 58.

UNIT– IV: **15 Hrs.**

General Preliminaries on Banach Algebras: Definition and some examples – Regular and singular elements – Topological divisors of zero spectrum – the formula for the spectral radius – the radical and semi-simplicity.
Chapter 12 : Sections 64 to 69.

UNIT– V: **15 Hrs.**

Structure of Commutative Banach Algebras: The Gelfand mapping – Applications of the formula r(x) = lim ||xn||1/n -Involutions in Banach Algebras - The Gelfand-Neumark Theorem.
Chapter 13 : Sections 70 to 73.

Books for Study:

G.F. Simmons, 1963,Reprint edition 1983,Introduction to Topology and Modern Analysis, McGraw Hill international Book Company, New York.

Books for Reference:

1. G. Bachman & L. Narici, 1966,Reprint 2000,Functional Analysis Academic Press, New York. 1966,Reprint 2000.
2. M. Fabian, P. Habala, P. Hajek, V. M. Santalucia, J. Pelant and V. Zizler, 2001,Functional analysis and infinite-dimensional geometry, Canadian Math. Soc, Springer .
3. H.C. Goffman and G. Pedrick, 1963, First course in Functional Analysis, Academic Press New York .
4. M. T. Nair, Fourth Print 2014,Functional analysis,PHI-Learning, New Delhi.
5. W .Rudin , 1973 ,Reprint 2006, Functional Analysis Tata Mcgraw- Hill Publising Company New Delhi.

Web Resources:

1. https://ocw.mit.edu/courses/mathematics/18-102-introduction-to-functional-analysis-spring-2009/lecture-notes/
2. https://www.math.kit.edu/iana1/lehre/funcana2012w/media/fa-lecturenotes.pdf
3. https://www.mimuw.edu.pl/~aswiercz/AnalizaF/lecture.pdf
4. https://users.math.msu.edu/users/schenke6/920/920notes.pdf
5. https://www.ams.org/books/gsm/143/gsm143-endmatter.pdf

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**2**	**2**	**2**	**2**
CO 2	**3**	**1**	**2**	**2**	**1**	**1**
CO 3	**3**	**2**	**3**	**2**	**0**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**2**
CO 5	**3**	**3**	**2**	**1**	**1**	**2**
Average	**3**	**2.4**	**2.2**	**1.8**	**1**	**1.6**

PEDAGOGY:

Chalk & Talk, Powerpoint presentation,Group Discussion,Seminar,Quiz through Google forms,Assignment through Online and Off line mode.

CORE PAPER XI

DIFFERENTIAL GEOMETRY

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMCT4011**

CREDIT : 4 **L,T, P : 5 , 1, 0**

COURSE OBJECTIVES:

1. To learn some applications of algebra and analysis in geometrical problem.
2. To provide knowledge of the geometry curves and surfaces.
3. To identify physical situation and model the same using Tensor calculus.

COURSE OUTCOMES: on completion of the course the students will be able to…

CO No.	CO Statement
CO1	To introduce the concept of space curves, surfaces and their properties.
CO2	To explain various concept of intrinsic properties of differential geometry.
CO3	To understand the theory of differential geometry of fundamental existence theorem, canonical geodesic equation and geodesic curvature.
CO4	To understand the concept of tensor variables and difference from scalar or vector variables.
CO5	Express the transformation of tensors. Explain the first and second kind of christoffel's symbols

SYLLABUS:

Unit-I: **15 Hrs**.

Space Curves: Definition of a space curve – Arc length – Tangent, normal and binormal – Curvature and torsion - Contact between curves and surfaces – Tangent surfaces, involutes and evolutes – Intrinsic equations – Fundamental Existence Theorem forspace curves-Helices.

Chapter I : Sections: 1 to 9

Unit-II: **15 Hrs**.

Intrinsic properties of a surface: Definition of a surface – Curves on a surface – Surface of revolution –Helicoids – Metric – Direction Coefficients – Families of curves.

Chapter II :Sections: 1 to 7

Unit-III: **15 Hrs.**

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence Theorems – Geodesics curvature – Gauss Bonnet Theorem – Gaussian curvature – Surfaces of constant curvature.
Chapter II : Sections: 10 to 18 (omit sections 13 and 14)

Unit-IV: **15 Hrs.**

Invariance –Transformation of coordinates and its properties – Transformation by Invariance - Transformation by covariance and contra variance – The Tensor concept: Contravariant and Covariant Tensors-Tensor Character of Covariant and Contravariant Laws - Algebra of tensors – Quotient Laws - Symmetric and Skew-Symmetric Tensors.
Chapter II : sections: 18 to 27 (omit sec.28) I.S.Sokolnikoff

Unit-V: **15 Hrs.**

The Metric tensor – The Fundamental and Associated Tensors – Christoffel's symbols – Covariant Differentiation of Tensors – Formulas for Covariant Differentiation – Ricci's theorem.
Chapter II : sections: 29 to 35 (omit sec.32) I.S.Sokolnikoff

Books for Study:

For Unit 1, Unit 2 and Unit 3 T.J Willmore,2002,An Introduction to Differential Geometry Oxford University press, (17th Impression) New Delhi (Indian print).

For Unit 4 and Unit 5 I.S Sokolnikoff, Tensor Analysis,1964, John Wiley and Sons New York.

Books for Reference:

1.J.A Thorpe ,2004,Elementary Topics in Differential Geometry Springer International Edition.
2. Andrew Pressley,2001, Elementry differential geometry, Springer.
3. Jain. S. K.,2002, Differential Geometry, sarup & Sons.
4. D. Somasudaram, 2005,Differential Geometry, Alpha Science International Limited.
5. J.M. Lee, 2009,Manifolds and Differential geometry ,publisher AMS, Roode Island.
6. U.C De. Absos Ali Shaikh and Joydeep Sengupta, 2004,Tensor Calculus, Narosa Publishing House, New Delhi.

E-RESOURCES

1. http://www.math.utk.edu/~wilkins/smoothmanifoldnotes.pdf
2. https://www.researchgate.net/publication/264871899_Lecture_Notes_Introduction_to_Differential_Geometry_MATH_442
3. http://assets.vmou.ac.in/MAMT04.pdf
4. **https://swayam.gov.in**
5. mathworld.forum.com

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**2**	**1**	**1**	**2**
CO 2	**3**	**1**	**2**	**2**	**1**	**1**
CO 3	**3**	**2**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**2**
CO 5	**3**	**3**	**2**	**1**	**1**	**2**
Average	**3**	**2.4**	**2.2**	**1.4**	**1**	**1.6**

PEDAGOGY:

Chalk & Talk, Power point presentation, Group Discussion, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

ELECTIVE PAPER IV

CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMET4004**

CREDIT : 3 **L,T, P : 4 , 2, 0**

COURSE OBJECTIVES:

1. To understand the basic techniques of Calculus of variations and Investigates methods that permit finding extremals of functional for both fixed and moving boundary points

2. To enable the students to acquire knowledge about the integral equation, its classification ,different kinds of kernels.
3. To know about successive approximations, resolvent kernel of a integral equation, use the theory, methods and techniques of integral equations to solve problems

COURSE OUTCOMES:

CO No.	CO Statement
CO1	Understand various types of Functional and Integral equations.
CO2	Study Volterra and Fredholm's Integral Equations and Apply different methods to solve Integral Equations.
CO3	Find Necessary and Sufficient condition for a functional to achieve extremals.
CO4	Investigate the functional with fixed and moving boundary points.
CO5	Apply the Fundamental Lemma of Calculus of Variations and Solve Variational problems.

SYLLABUS

Unit-I: **15 Hrs.**

The method of Variations in problems with fixed boundaries: Variation and its properties – Euler's equation – Functionals of the form $\int F(x,y_1,y_2,\ldots y_n,y_1',y_2,'\ldots y_n')dx$. – unctional dependent on higher-order derivatives – unctional dependent on the functions of several independent variables – variational problems in parametric form – some applications.

Chapter 6 : Sections 1 to 7 (Elsgolts)

Unit-II: **15 Hrs.**

Variational problems with moving boundaries and certain other problems And sufficient conditions for an extremum: An elementary problem with moving boundaries - the moving – boundary problem for a functional of the form $\int f(x,y,z,y',z')dx$ – extremals with corners – one-sided variations. Field of extremals – the function $E(x,y,p,y')$ – transforming the Euler's equations to the canonical form.

Chapter 7 : Sections 1 to 4 (Elsgolts)

Chapter 8 : Sections 1 to 3 (Elsgolts)

Unit-III: **15 Hrs**.

Integral Equations: Definition-regularity conditions-special kinds of kernels-eigen values and eigen functions-convolution integral-the inner or scalar product of two functions.Integral Equations with separable kernels:Reduction to a system of algebraic equations- examples-Fredholm alternative-examples-an approximate method.

Chapter 1 : Sections 1.1 to 1.7 (Kanwal)

Chapter 2 : Sections 2.1 to 2.5 (Kanwal)

Unit-IV: **15 Hrs.**

Method of successive approximations: Iterative scheme-examples-Volterra integral equation-examples-Some results about the resolvent kernel.

Classical Fredholm Theory: The method of solution of Fredholm-Fredholm's first theorem-examples-Fredholm's second theorem-Fredholms third theorem.

Chapter 3 : Sections 3.1 to 3.5 (Kanwal)

Chapter 4 : Sections 4.1 to 4.5 (Kanwal)

Unit-V: **15 Hrs.**

Symmetric Kernels: Introduction-fundamental properties of eigen values and eigen functions for symmetric kernels-expansion in eigen functions and bilinear form-Hilbert- Schmidt theorem and some immediate consequences-solution of a symmetric integral equation-examples.

Singular Integral Equations: The Abel integral equation-examples-Cauchy principle value for integrals-the Cauchy-type integrals-solution of the Cauchy-type singular integral equation.

Chapter 7 : Sections 7.1 to 7.6 (Kanwal)

Chapter 8 : Sections 8.1 to 8.5 (Kanwal)

Books for Study:

For Units 1 and Unit 2 : L. Elsgolts, 1973 (2nd Edition) Differential Equations and the Calculus of Variations, Mir Publishers, Moscow.

For Units 3,Unit 4 and Unit 5 : Ram P. Kanwal, 1971,Linear Integral Equations, Academic Press, New York.

Books for Reference:

1. M. D. Raisinghania,2007, Integral Equations and Boundary Value Problems, S. Chand & Co., New Delhi.
2. Sudir K. Pundir and Rimple Pundir, 2005,Integral Equations and BoundaryValue Problems , Pragati Prakasam, Meerut.
3. A. S. Gupta, 2005,Calculus of Variations with Applications, PHI, New Delhi.

E Resources

1. mathworld.forum.com
2. www.colorado.edu
3.www.science direct.com
4. www.hindawi.com www.gregschool.org/lagrangian - mechanics/2017

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**3**	**1**	**1**	**3**
CO 2	**3**	**2**	**3**	**1**	**1**	**3**
CO 3	**3**	**3**	**3**	**1**	**1**	**3**
CO 4	**3**	**3**	**3**	**1**	**1**	**3**
CO 5	**3**	**3**	**3**	**1**	**1**	**3**
Average	**3**	**2.6**	**3**	**1**	**1**	**3**

PEDAGOGY:

Chalk & Talk, Blended Learning, Screen sharing, Powerpoint presentation, Flipped learning, Encouraging Discussions, Seminar, Quiz through Google forms, Assignment through Online and Off line mode.

ELECTIVE V-Operations Research

TOTAL HOURS / WEEK: 6 **SUB CODE: 20PAMET4005**

CREDIT : 3 **L,T, P : 4 , 2, 0**

COURSE OBJECTIVES:

1. To enlight the students Mathematical techniques to model and analyze decision problems, with effective applications to real life in optimization of objectives.
2. To gain the knowledge in inventory control and queuing problems.
3. To understand the concept of Non linear Programming Problem.

COURSE OUTCOMES: on completion of the course the students will be able to…

CO No.	CO Statement
CO1	Apply Duality to solve the linear programming problem
CO2	Apply problem solving techniques to solve the Dynamic programming problems.
CO3	Demonstrate the Inventory control models and apply this model to solve real life problems .
CO4	Study the Queuing theory and its applications.
CO5	Describe and solve the constrained and unconstrained optimization problems.

SYLLABUS

UNIT– I: **15 Hrs.**

Duality in Linear Programming: Introduction – Formulation of Dual Linear Programming Problem.
Revised Simplex Method: Introduction – Standard Forms for Revised simplex method – Computational procedure for standard form I – Comparison of Simplex method and Revised simplex method.
Dual - Simplex Method: Introduction – Dual – Simplex Algorithm.
Chapter: 5 Sections: 5.1 & 5.2
Chapter: 26 Sections: 26.1-26.4
Chapter: 27 Sections: 27.1 & 27.2

UNIT– II: **15 Hrs.**

Dynamic Programming Problems (DPP): Dynamic programming terminology –Developing optimal decision policy -Dynamic programming under certainity- Dynamic programming approach for solving LPP.
Chapter20: Sections: 20.1-20.5

UNIT– III: **15 Hrs.**

Inventory Models: Introduction-Basic concepts- Inventory control models without shortages(model I(a) EOQ model with constant rate of demand) , (model I (c) : EOQ model with Economic production model when supply is gradual) – Inventory control models with shortages (model II (a): EOQ model with constant rate of demand and variable order cycle time .
Chapter 14: Sections: 14.1 – 14. 8

UNIT– IV: **15Hrs.**

Inventory models (cont) : Inventory control models with shortages ,(model II (b): EOQ model with constant rate of demand and fixed reorder cycle time,) (model II (c):EOQ model with gradual supply) Chapter 14: Section: 14. 8.

Queueing Theory: Introduction-Basic concepts - Probability Distribution of Arrivals and Departures- Erlangian Service Time Distribution with K-Phases.
Chapter 16:Sections: 16.1- 16.4 Appendix : 16. A, 16. B

UNIT– V: **15 Hrs.**

Classical Optimization Theory: Unconstrained optimization –constrained multivariable optimization with equality constrained multi variable optimization with inequality constrained.
Chapter 23 : Sec 23.1–23.4

Non-Linear Programming :The general non linear programming problem – Quadratic programming .
Chapter 24: Sections: 24.1, 24.2, 24.4(omit 24.3 & 24.4.3)

Books for Study:

J.K. SHARMA (1997-2003),Operations Research Theory and Application (III Edition), Macmillan India Limited.

Books for Reference:

1. Man Mohan, P.K. Gupta, Kanti Swarup , 2005,Operations Research, Sultan chand & sons .
2. J,K. Sharma , 2007,Operations Research, Macmillan India limited .
3. Hamdy A . Taha , 2008,Operations Research, Pearson Prentice Hall of India Pvt. Ltd, New Delhi .
4. Kanti Swarup, P.K. Gupta, Man Mohan, 2001,Operations Research, Sultan chand & sons .
5. V. Sundersan , K.S. Ganapathy Subramanian, K.Ganesan,2016 ,Resource Management Techniques A.R.Publications,India.

E - RESOURCES:

1. **https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf.**
3. **https://coral.ise.lehigh.edu/magh/present/stetson01.pdf**
4. **https://www.ncertbooks.guru/operation-research-notes/**
5. **https://www.studocu.com/row/document/kenya-methodist-university/business-information-technology/lecture-notes/operations-research-notes/7381343/view**
6. **https://www.mathcity.org/msc/notes/operation_research**

Mapping of CO with PSO

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	2	2	3
CO 2	3	3	3	3	2	1
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	1
CO 5	3	2	2	3	2	2
Average	3	3.4	2.6	3.4	2	1.8

PEDAGOGY:

Chalk & Talk, Powerpoint presentation,Group Discussion,Seminar,Quiz through Google forms,Assignment through Online and Off line mode.

Core project I

PROJECT

SUBJECT CODE : 20PAMPR4001

Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women (Autonomous)

Re-accredited with "A+" Grade by NAAC

Amendments in the regulations from 2020 – 2021 onwards

PG

Changes in Part-II

Semester – I

Title	Internal Marks	External Marks	Credits
Skill based elective-Teaching Skills	50	-	3

Semester – II

Title	Internal Marks	External Marks	Credits
Soft Skills – SWAYAM (MOOC)	50	-	4

Semester – III

Title	Internal Marks	External Marks	Credits
Skill based elective -Research Skills	50	-	3

Semester – IV

Title	Internal Marks	External Marks	Credits
Extra Disciplinary– SWAYAM (MOOC)	50	-	4