CURRICULUM AND SYLLABI

CHOICE BASED CREDIT SYSTEM (CBCS- PG)

M.Sc MATHEMATICS PROGRAMME

INTRODUCED FROM 2020 ADMISSION ONWARDS

Department of Mathematics

Sacred Heart College (Autonomous), Thevara, Kochi, Kerala

CONTENTS

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S H College(Autonomous) , Thevara .

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Postgraduate Programme Outcomes (Pos)

At the end of the programme the students are able to,

PO1 : Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.

PO2 : Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.

PO3 : Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.

PO4 : Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.

PO5 : Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

Programme Specific Outcomes (PSOs)

At the end of the programme a student should be able to:

PSO1 : Assimilate and analyse advanced concepts in Mathematics.

PSO2 : Develop problem-solving skills and apply them independently to solve problems in pure and applied mathematics.

PSO3 : Develop skills to mathematically model real-time problems and apply mathematical tools to solve them.

PSO4 : Inculcate an aptitude for research.

REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER

1. **Title**

These regulations shall be called '**REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (CSS)– 2020'**

2. Scope

Applicable to all Post Graduate (PG) programmes of the college with effect from 2020-21 admissions. The provisions herein supersede all the existing regulations for the Post Graduate programmes of the college.

3. Definitions

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

ii. 'Duration **of Programme'** means the period of time required for the conduct of the programme. The duration of post-graduate programme shall be of 4 semesters and M Phil programmes shall be 2 semesters.

iii. **'Semester'** means a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days, each with 5 contact hours of one hour duration

iv. **'Course'** means a segment of subject matter to be covered in a semester. Each Course is to be designed variously under lectures / tutorials / laboratory or fieldwork/ study tour /seminar / project / practical training / assignments/evaluation etc., to meet effective teaching and learning needs.

v. **'Credit' (Cr)** of a course is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

vi. '**Extra credits**' are additional credits awarded to a student over and above the minimum credits required for a programme

vii. '**Programme Credit'** means the total credits of the PG/M Phil Programmes. For PG programmes the total credits shall be 80 and for M.Phil. it shall be 40.

viii. **'Programme Elective course'** Programme Elective course means a course, which can be chosen from a list of electives and a minimum number of courses is required to complete the programme.

ix. '**Programme Project'** Programme Project means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department / any appropriate Institute in order to submit a dissertation on the project work as specified.

x. '**Internship**' is on-the-job training for professional careers.

xi. '**Plagiarism**' Plagiarism is the unreferenced use of other authors' material in dissertations and is a

serious academic offence.

xii. '**Seminar'** seminar means a lecture by a student expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

xiii. '**Evaluation'** means every course shall be evaluated by 25% continuous (internal) assessment and 75% end course/end semester (external) assessment.

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

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

xvi. '**Department'** means any teaching Department offering a course of study approved by the college / Institute as per the Act or Statute of the University.

xvii. '**Department Council'** means the body of all teachers of a Department in a College.

xviii. **'Faculty Advisor'** is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.

xix. '**College Co-ordinator** means a teacher from the college nominated by the College Council to look into the matters relating to CSS-PG System.

xx. **'Letter Grade'** or simply '**Grade**' in a course is a letter symbol (O, A, B, C, D, etc.) which indicates the broad level of performance of a student in a course.

xxi. Each letter grade is assigned a **'Grade point'** (GP) which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

xxii. **'Credit point'** (CP) of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course CP=GP x Cr.

xxiii. '**Semester Grade point average'** (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits taken by him/her in that semester . The grade points shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxiv. **Cumulative Grade point average'** (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

xxv. '**Grace Marks'** means marks awarded to course/s, as per the orders issued by the college from time to time, in recognition of meritorious achievements in NCC/NSS/Sports/Arts and cultural activities.

4. ATTENDANCE

Being a regular college, physical presence in the regular activities, especially, classes and exams, is mandatory for the students. However, if a student secures 75% of attendance he/she is eligible to

appear for the exams, provided there are no other impediments like disciplinary proceedings, malpractice record etc.

i. **Absence:**A student found absent for one hour in the forenoon or afternoon session is deprived of the attendance for the entire session as far as eligibility for final exam is concerned.

ii. The hour related calculation in a course is meant for awarding marks for the course concerned, where applicable.

iii. **Late entry**: A student is supposed to be in time for the class. Late arrival related treatment is left to the discretion of the individual teacher. However, as a norm, a late arriving student may be permitted to the class, if it is not inconvenient or distraction to the class as such; though attendance MAY NOT BE GIVEN. Late arrival beyond 5 minutes is treated as ABSENCE; though the teacher may consider permitting the student to sit in the class.

iv. **Leave** : A student has to formally report his/her absence with reasons either in advance, or immediately after the absence for obtaining an approved leave. This applies to all sorts of leave – medical, on duty or other.

v. The student is supposed to report in prescribedformat on the very next day of the absence; however, upto a week's time is permitted. Afterwards, the leave applications will not be considered.

vi. The student has to retain a copy/section of the approved leave form and produce the same as proof, in case there is any confusion regarding the leave sanctioning. In the absence of such proof, the claims will not be entertained.

vii. **Duty Leave**: A student representing the college in sports, arts, social service or academic matters, has to get sanction from the class teacher concerned and submit the leave application form duly endorsed by the class teacher and Head of the department, and submit it to the Vice Principal. The same will be forwarded by the Vice Principal for attendance entry. **SPORTS**: The approval of the Department of Physical Educationand the class teacher is required. The time limit for submission mentioned above is applicable in the case of duty leave as well.

viii. **Condonation**: A student may have the privilege of condonation of attendance shortage (upto a maximum of 10 days) on the basis of genuineness of the grounds of absence (medical reasons or college duty), duly recommended by the department. This is not a matter of right. It is a matter of privilege based on Principal's discretion and the good conduct of the student on the campus. A student of PG programme may have onlyone such opportunity.

ix. **Re-admission**: A student whose attendance is inadequate will have to discontinue the studies. Such students, whose conduct is good, may be re-admitted with the approval of governing council, on the basis of recommendation from the department, and assurance from the student and the guardian regarding good conduct and compliance in academic and discipline matters. For this the prescribed re-admission fee has to be paid.

As a condition for re-admission, the student should have cleared all academic arrears, or should have appeared for the exams in which he/she is having an arrear (if the results are not out), and should have fulfilled all academic assignments prescribed by the department for compensating for his lack of attendance.

x. **Unauthorised absence & removal from rolls**: A student absent from the classes continuously for 10 consecutive working days without intimation or permission, shall be removed from the rolls, and the matter intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the Principal.

5. PROGRAMME REGISTRATION

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

ii. A PG student who registered for the programme shall complete the same within a period of 8 continuous semesters from the date of commencement of the programme.

6. PROMOTION: A student who registers for the end semester examination shall be promoted to the next semester. However, in extreme circumstances, a student having sufficient attendance who could not register for the end semester examination may be allowed to register notionally by the Principal with the recommendation of the Head of the department concerned and, by paying the prescribed fee.

7. EXAMINATIONS

All the End Semester Examinations of the college will be conducted by the Controller of Examination. The Principal will be the Chief Controller of Examinations. An Examination committee consisting of the Chief Controller of Examinations, Controller of Examinations, Additional Chief Superintendent, Deans, IQAC Coordinator and other faculty members nominated by the Principal will act as an advisory body on the matters relating to the conduct of examinations.

8. EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts;

a. **Continuous Internal Assessment (CIA) and**

b. **End Semester Examination (ESE).**

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. For all courses except the courses offered by the school of communications, there shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation. In the case of courses offered by the school of communications,the internal to external assessment ratio shall be 1:1. (In their cases, the components for evaluation and their respective marks shall be determined by their Board of Studies).Both internal and external evaluation shall be carried out in the mark system and the marks are to be rounded to the nearest integer.

a. Continuous Internal Assessment (CIA)/ Continuous Assessment: The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars/viva/field study/industrial visits/study touretc.with respect to theory courses and based on written tests, lab skill/records/vivavoceetc.with respect to practical courses. The marks assigned to various components for internal evaluation as follows.

Components of Internal Evaluation (for theory)

	Components	Marks
i	**Assignments**	**5**
ii	**Seminar**	**5**

iii	**Quiz/Field study/Industrial Visit/Viva Voce/Study Tour/etc.**	**5**
iv	**Two Test papers(2x5)**	**10**
	Total	**25**

i. **Assignments**: Every student shall submit one assignment as an internal component for every course.

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Components	**Marks**
Punctuality	1
Content	2
Conclusion	1
Reference/Review	1
Total	**5**

ii. **Seminar**: The seminar lecture is expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation. .

Components	**Marks**
Content	2
Presentation	2
Reference/Review	1
Total	**5**

iii. A quiz or viva or field survey or any suitable method shall be used by the course teacher to assess the students and a maximum of 5 marks shall be awarded for this component

iv. **Class Tests**: Every student shall undergo two class tests as an internal component for every course.

Components of Internal Evaluation (for practical)

Components	**Marks**
Laboratory Involvement	5
Written/ Lab Test (2X5)	10
Record	5
Viva Voce	5
Total	25

b. End Semester Examination (ESE): The End Semester Examination in theory courses shall be conducted by the college with question papers set by external experts/ question bank. The evaluation

of the answer scripts shall be done by the examiners based on a well-defined scheme of evaluation given by the question paper setters/Prepared as per the direction of the Chairman, Board of Examiners. The evaluation of the End Semester Examinations shall be done immediately after the examination preferably through the centralised valuation.

c. Project

Project work is a part of the syllabus of most of the programmes offered by the college. The guidelines for doing projects are as follows:

i. Project work shall be completed by working outside the regular teaching hours.

ii. Project work shall be carried out under the supervision of a teacher in the concerned department or an external supervisor.

iii. A candidate may, however, in certain cases be permitted to work on the project in an industrial / Research Organization/ Institute on the recommendation of the Supervisor.

iv. There should be an internal assessment and external assessment for the project work in the ratio 1:3

v. The external evaluation of the project work consists of valuation of the dissertation (project report) followed by presentation of the work and viva voce.

vi. The mark and credit with grade awarded for the program project should be entered in the grade card issued by the college.

Components of Internal Evaluation for Projects

Components	**Marks**
Topic/Area selected	2
Experimentation/Data collection	5
Punctuality-Regularity	3
Compilation	5
Content	5
Presentation	5
Total	**25**

Vii. **Components of External Evaluation for Projects**

Components	**Marks**
Topic/Area selected	5
Objectives	10
Experimentation/Data collection	15
Content/Analysis	20
Presentation	10
Conclusions/Findings/Summary	10
Reference	5
Total	**75**

d. Comprehensive Viva-voce

Comprehensive Viva-voce shall be conducted at the end of the programme, which covers questions from all courses in the programme as per the syllabus.

e. Grade and Grade Points

For all courses (theory & practical), Letter grades and grade point are given on a 10-point scale based on the total percentage of marks, (CIA+ESE) as given below:-

Percentage of Marks	Grade	Grade Point (GP)
95 and above	O Outstanding	10
85 to below 95	A^+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B^+ Good	7
55 to below 65	B Above Average	6
45 to below 55	C^+ Average	5
40 to below 45	C Pass	4
Below 40	F Fail	0
	Ab Absent	0

Grades for the different semesters and overall programme are given based on the corresponding SGPA/CGPA as shown below:

SGPA/CGPA	Grade
Equal to 9.5 and above	***O Outstanding***
Equal to 8.5 and below 9.5	***A+ Excellent***
Equal to 7.5 and below 8.5	***A Very Good***
Equal to 6.5 and below 7.5	***B+ Good***
Equal to 5.5 and below 6.5	***B Above Average***
Equal to 4.5 and below 5.5	***C^+ Average***
Equal to 4.0 and below 4.5	***C Pass***
Below 4.0	***F Failure***

A **separate minimum of 40% marks** required for a pass for both internal evaluation and external evaluation for every PG programme.

A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the end semester examination for the same semester, subsequently.A student who fails to secure a minimum marks/grade for a pass in a course can be permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student

in that semester is calculated using the formula given below. For the successful completion of semester, a student should pass all courses and score at least the minimum CGPA grade **'C'**. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

Credit Point (CP) of a course is calculated using the formula
CP = Cr x GP, where Cr = Credit; GP = Grade point
Semester Grade Point Average (SGPA) of a Semester is calculated using the formula
SGPA = TCP/TCr, where

TCP = Total Credit Point of that semester $\sum_{1}^{n} CPi$**;**

TCr = Total Credit of that semester $\sum_{1}^{n} Cri$

Where n is the number of courses in that semester
Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

CGPA $\frac{\sum (SGPA \times TCr)}{\sum TCr}$

SGPA/CGPA shall be round off two decimal places

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board/website at least one week before the commencement of external examination. There shall not be any chance for improvement for internal mark.

The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the controller of examinations through the Head of the Department and a copy should be kept in the department for at least two years for verification.

9 Admission

The eligibility criteria for admission to all PG programmes shall be published by the college along with the notification for admission.

10 **Registration for the examination**

a. All students admitted in a programme with remittance of prescribed fee are eligible for the forthcoming semester examinations.
b. Online application for registration to the various End Semester Examinations shall be forwarded to the CE along with prescribed fee for each course in prescribed format.
c. The eligible candidates who secure the prescribed minimum attendance of the total duration of the course and possess other minimum qualification prescribed in the regulations for each

course shall be issued the hall tickets. The hall ticket shall be downloaded by the students from the college website.

d. The mode of fee remittance shall be through the prescribed bank.

11 **Supplementary Examinations**

Candidates who failed in an examination can write the supplementary examination conducted by the College along with regular examinations.

12 **Improvement of Examination**

There will be no improvement examinations for PG programmes

13 **Promotion to the Next Higher Semester**

A candidate shall be eligible for promotion from one semester to the next higher semester if,

a. He / she secures a minimum 75 % attendance and registered for the End Semester Examination of the programme for which he/she is studying.

b. His / her progress of study and conduct are satisfactory during the semester completed, as per the assessments recorded by the course teachers and the Head of the Department concerned.

14. **Certificates**

1. Diploma and Degree certificates are issued by the Mahatma Gandhi University, Kottayam as per the act and statues of the University on the submission of the consolidated mark / score cards of the students by the College.

2. A consolidated mark / scored card shall be issued to the candidates after the publication of the results of the final semester examination taken by the candidate.

3. A Course Completion Certificate with classification shall be issued to students till the provisional certificate is issued by the university.

15. Award of Degree

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

16. Monitoring

There shall be a Monitoring Committee constituted by the Principal consisting of faculty advisors, HoD, a member from teaching learning evaluation committee (TLE) and the Deans to monitor the internal evaluations conducted by college. The Course teacher, Class teacher and the Deans should keep all the records of the internal evaluation, for at least a period of two years, for verification.

Every Programme conducted under Credit Semester System shall be monitored by the College Council under the guidance of IQAC Coordinator, Controller of Exams, academic Deans and HoDs. An academic committee consisting of the Vice Principal, Deans and teachers nominated by

the Principal shall look after the day-to-day affairs of these regulations.

17. Grievance Redressal Mechanism

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: At the level of the concerned course teacher

Level 2: At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3: A committee with the Principal as Chairman, Dean of the Facultyconcerned, HOD of the department concerned and one member of the Academic council nominated by the principal in every year.

18.SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI-13

Msc . MATHEMATICS PROGRAMME (2020 admission onwards)

Semester	Course Code	Teaching Hours/week	Credit
Semester I	20P1MATT01 20P1MATT02 20P1MATT03 20P1MATT04 20P1MATT05	5 5 5 5 5	4 4 4 4 4
Total		25	20
Semester II	20P2MATT06 20P2MATT07 20P2MATT08 20P2MATT09 20P2MATT10	5 5 5 5 5	4 4 4 4 4
Total		25	20

Semester III	20P3MATT11 20P3MATT12 20P3MATT13 20P3MATT14 20P3MATT15	5 5 5 5 5	4 4 4 4 4
Total		25	20
Semester IV	20P4MATT16 20P4MATT17 ELECTIVE -1 ELECTIVE -2 ELECTIVE -3	5 5 5 5 5	4 4 3 3 3
Total		25	17
PROJECT	20P4MATPJ		1
VIVA VOCE	20P4MATCV		2

19.*QUESTION PAPER PATTERN*

Questions shall be set to assess the level of knowledge acquired by the students , the ability to use the knowledge in solving practical problems , critical evaluation of knowledge and the ability to synthesize knowledge. The question paper setter shall ensure that all skills envisaged in the syllabus are covered. He/ shall submit the scheme of evaluation along with the question paper.

The question paper consists of three Parts namely **PART -A ,PART -B** and **PART -C** . In part-A there are **8** questions and answer any **5**,all questions carry **2 marks**. In part –B there are **8** questions and answer any **5** , all questions carry **5marks**. In part- C there are **4** questions ,one from each of the **4** modules. In each question there are two sections and answer any one (**compulsory**) and each question carries **10marks**

Illustration

Module	Part-A [Answer any 5 , two marks each]	Part–B [Answer any 5 , five marks each]	Part–C [Answer one from each module , ten marks each]	Total number of questions
Module I	*3*	*2*	*2*	*7*
Module II	*2*	*3*	*2*	*7*
Module III	*1*	*2*	*2*	*5*
Module IV	*2*	*1*	*2*	*5*
No. of questions to be answered	**5**	**5**	**4**	**14**
Total marks	5x2= 10	5x5 = 25	4x10 = 40	75

PROGRAMME STRUCTURE

COURSE CODE	SEM	NAME OF THE COURSE	HR / W	CR	T CR	T HR/SEM
20P1MATT01	I	LINEAR ALGEBRA	5	4	20	75
20P1MATT02		ALGEBRA	5	4		75
20P1MATT03		REAL ANALYSIS	5	4		75
20P1MATT04		ORDINARY DIFFERENTIAL EQUATIONS	5	4		75
20P1MATT05		OPTIMIZATION TECHNIQUES	5	4		75
20P2MATT06	II	BASIC TOPOLOGY	5	4	20	75
20P2MATT07		COMPLEX ANALYSIS	5	4		75
20P2MATT08		GRAPH THEORY	5	4		75
20P2MATT09		NUMBER THEORY	5	4		75
20P2MATT10		MEASURE THEORY AND INTERATION	5	4		75
20P3MATT11		PARTIAL DIFFERENTIAL EQUATIONS	5	4	20	75
20P3MATT12		FUNCTIONANALYSIS	5	4		75
20P3MATT13		ADVANCED TOPOLOGY	5	4		75

20P3MATT14	III	ADVANCED COMPLEX ANALYSIS	5	4		75
20P3MATT15		MULTIVARIATE CALCULUS	5	4		75
20P4MATT16	(Two compulsory papers & 3 Electives out of 6) Semester IV	ADVANCED FUNCTIONAL	5	4	20	75
20P4MATT17		DIFFERENTIAL GEOMETRY	5	4		75
20P4MATTEL18		PROBABILITY THEORY	5	3		75
20P4MATTEL19		NUMERICAL ANALYSIS	5	3		75
20P4MATTEL20		THEORY OF WAVELETS	5	3		75
20P4MATTEL21		ALGEBRAIC TOPOLOGY	5	3		75
20P4MATTEL22		INTRODUCTION TO CHAOTIC DYNAMICAL SYSTEMS	5	3		75
20P4MATTEL23		ABSTRACT HARMONIC ANALYSIS	5	3		75
20P4MATPJ		PROJECT/ DISSERTATION		1		100
20P4MATCV		VIVA VOCE		2		100
TOTAL CREDITS						**80**

SEMESTER- I

COURSE: 20P1MATT01: LINEAR ALGEBRA

Hours perweek:5 **Total Credits:4**

Course Outcomes

CO1: Recalling vector spaces, subspaces, basis and dimension and understanding coordinates and summary of row equivalence.
CO2: Understanding linear transformations their algebra and representation of transformations by matrices.
CO3: Assimilate ideas of canonical forms, characteristic values and annihilating polynomials.
CO4: Developing ideas of simultaneous triangulation and diagonalisation and direct sum decomposition.

Text Book: Kenneth Hoffman / Ray Kunze (Second Edition), *Linear Algebra*, Prentice-Hall of India Pvt. Ltd., New Delhi, 1992.

Module-1 **(12 hours)**

Vector spaces, subspaces, basis and dimension

(Chapter 2, 2.1, 2.2, 2.3 of the text)(Proof of theorems excluded)

Co-ordinates, summary of row-equivalence

(Chapter 2- 2.4 & 2.5 of the text)

Module-2 **(25 hours)**

Linear transformations, the algebra of linear transformations, isomorphism, Representation of transformations by matrices, linear functional, double dual, Transpose of a linear transformation.

(Chapter 3 - 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 & 3.7 of the text)

Module-3 **(15 hours)**

Introduction to elementary canonical forms, characteristic values, annihilating Polynomials.

(Chapter 6 - 6.1, 6.2, and 6.3 of the text)

Module-4 **(23 hours)**

Invariant subspaces, simultaneous triangulations, simultaneous diagonalisation, direct sum decompositions, invariant direct sums. (Chapter 6 – 6.4, 6.5 & 6.6 of the text)

References:

1. Klaus Jonich. Linear Algebra, SpringerVerlag.

2. Paul R. Halmos, Linear Algebra Problem Book, The Mathematical Association ofAmerica.

3. S. Lang, Algebra, 3rd edition, Addison-Wesley,1993.

4. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi,2000.

5. S. Kumaresan, Linear Algebra A Geometrical Approach, Prentice Hall of India,2000.

Question paper Pattern

Module	**Part A** **(2 Marks Question)** **Answer any five** **Questions**	**Part B** **(5 Marks Question)** **Answer any five**	**Part C** **(10 Marks Question)** **Answer one from each module**
1	2	2	2
2	2	2	2
3	2	2	2
4	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P1MATT02: ALGEBRA

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Developing ideas of finitely generated abelian groups, Sylow theorems and applications
CO2: Understanding the concept of rings of polynomials, factorization of polynomials and ideal structure.
CO3: Assimilating the idea of extension fields, algebraic extensions and geometric constructions.
CO4: Developing ideas of automorphisms of fields, isomorphism extension theorem and Galois theory.

Text Book: John B. Fraleigh, A First Course in Abstract Algebra, 7th edition, Pearson Education.

Module 1: **(22 hours)**

Direct products and finitely generated Abelian groups, fundamental theorem (without proof), Group action on a set. Sylow's theorems (without proof), Applications of the Sylow theory

(Part II – Section 11) (Part III- Section 16) (Part VII Sections 36 & 37)

Module 2: **(20 hours)**

Rings of polynomials, factorisation of polynomials over a field, Ideal Structure in F[x].

(Part IV – Sections 22 & 23) (Part V-Section 27.21 -27.27)

Module 3: **(23 hours)**

Introduction to extension fields, algebraic extensions. Geometric Constructions, Finite fields.

(Part VI – Section 29, 31 – 31.1to31.18) (Part VI-Sections 32 and 33)

Module 4: **(15 hours)**

Automorphism of fields, the isomorphism extension theorem (proof of the theorem excluded) , Splitting fields, separable extensions, Galois theory.
(Part X – Section 48 & Section 49.1–49.5) (Part X–Sections50, 51 &Sections53)

References:-

1. Contemporary Abstract Algebra –Joseph .A.Gallian, Narosa Publishing House.

2. Abstract Algebra, by Davd S. Dummit and Richard M Foote, Wiley Publications.

3.I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi,1975.

4., Algebra, Hungerford, Springer

5. M. Artin, Algebra, Prentice -Hall of India, 1991

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five Questions**	**Part B** **(5Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P1MATT03: REAL ANALYSIS

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Studying functions of bounded variations, rectifiable curves, paths and equivalence of paths.

CO2: Developing the ideas of Riemann-Stieljes integral and studying integration and differentiation.

CO3: Assimilating the ideas of uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation.

CO4: Analyzing power series, exponential and trigonometric functions.

Text 1: Tom Apostol , Mathematical Analysis (second edition), Narosa Publishing House. Text 2: Walter Rudin, Principles of Mathematical Analysis (Third edition), International Student Edition.

Module-1 **(17hours.)**

Functions of bounded variation and rectifiable curves. Introduction, properties of monotonic functions, functions of bounded variation, total variation, additive property of total variation, total variation on(a,x) as a functions of x, functions of bounded variation expressed as the difference of increasing functions, continuous functions of bounded variation, curves and paths, rectifiable path and arc length, additive and continuity properties of arc length, equivalence of paths, change of parameter.

(Chapter 6, Section: 6.1 - 6.12. of Text 1)

Module2 **(18 hours.)**

The Riemann-Stielljes Integral. Definition and existence of the integral, properties of the integral, integrationand differentiation.

(Chapter 6 - Section 6.1 to 6.22 of Text 2)

Module3 **(22 hours.)**

Sequence and Series of Functions Discussion of main problem, uniform convergence, uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, the Stone-Weierstrass theorem (without proof).

(Chapter 7 Section. 7.7 to 7.18 of Text 2)

Module4 **(18 hours.)**

Some Special Functions, Power series, the exponential and logarithmic functions, the trigonometric functions, the algebraic completeness of complex field.

(Chapter 8 - Section 8.1 to 8.8 of Text 2)

References:

1. Royden H.L, Real Analysis, 2nd edition, Macmillan, NewYork.

2. Bartle R.G, The Elements of Real Analysis, John Wiley andSons.

3. S.C. Malik, Savitha Arora, Mathematical Analysis, New Age InternationalLtd.

4. Edwin Hewitt, Karl Stromberg, Real and Abstract Analysis, SpringerInternational,1978

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five** **Questions**	**Part B** **(5 Marks** **Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	1	2
II	2	2	2
III	2	2	2
IV	2	1	2
Total (75 MARKS)	15 Marks	20 Marks	40 Marks

COURSE: 20P1MATT04: ORDINARY DIFFERENTIAL EQUATIONS

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Understanding the method of successive approximation and learning Lipschitz condition and uniqueness theorem.

CO2: Analyzing the system of linear differential equations and studying the matrix method for homogenous linear system.

CO3: Appreciate Sturm Liouville Problems, the expansion of a function in a series of ortho normal functions.

CO4: Perceivenonlinear differential equations, critical points and paths of linear system andnonlinear system

Text Book 1: Differential Equations, Shepley L Ross, Wiley Student Edition, Third edition

Text Book 2: E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI.

Module1 : The method of successive approximations, The Lipschitz condition, Existence theorem, Non local existence of solutions, Uniqueness theorem, Equations with complex valued functions.

(Chapter 4 , sections 4,5,6,7,8,9 of Text 2) **(17hours)**

Module2 :System of Linear Differential Equations : Basic theory of Linear systems in normal form, Homogeneous linear systems with constant coefficients, Matrix method for homogeneous linear systems

(Chapter 7 sections 7.3, 7.4, 7.5 and 7.6 ofText1.) **(20 hours)**

Module3 . Boundary Value Problems : Sturm Liouville Problems , Orthogonally of Characteristic functions , the expansion of a function in a series of orthonormalfunctions

(Chapter 12, Sections 12.1, 12.2, 12.3 oftext1) **(20 hours)**

Module4:Nonlinear differential equations, Phase plane ,Paths and critical points, critical points and paths of linear system, critical points and paths of non linear system

(Chapter 13 Sections 13.1, 13.2 ,13.3 of text 1**)** **(18 hours)**

References:

- Elementary Differential Equations, 9th edition (7th or 8th ed ok), W. E. Boyce and R.C. Diprima, John Wiley and Sons,Inc
- Differential Equations, Second Edition, by J. Polking, A. Boggess and D. Arnold. Prentice Hall, 2006.
- Differential Equations, George F Simmons, Steven G Krantz, Tata McGraw-Hill - 2011

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any 4** **Questions**	**Part B** **(5 Marks** **Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

20P1MATT05: OPTIMIZATION TECHNIQUES

Hours per week:5 **Total Credits :4**

Course Outcomes

CO1: Understand the concept of Linear Programming problem, Duality and their solution.

CO2: Evaluate the optimal solution of Integer programming problem by using cutting plane method and branch and bound method.

CO3: Apply algorithm to find the solution of Goal programming problem, minimum path problem and maximum flow problem.

CO4: Understand the concept of Non – linear programming problem and different algorithm to solve them.

Text -1 K.V. Mital and C. Mohan, Optimization Methods in Operation Research and Systems Analysis, 3rd edition.
Text -2 Ravindran, Philips and Solberg. Operations Research Principle and Practice, 2nd edition, John Wiley and Sons.

Module 1: LINEAR PROGRAMMING (20 hours)

Simplex Method, Canonical form of equations, Simplex Method (Numerical Example), Simplex Tableau, Finding the first BFS and artificial variables, Degeneracy, Simplex multipliers, Revised simplex method, Duality in LPP, Duality theorems, Applications of Duality, Dual simplex method, Summery of simplex methods.
(Chapter 3; sections: 9 – 21 of text – 1)

Module2: INTEGER PROGRAMMING (15 hours)

I.L.P in two dimensional space – General I.L.P. and M.I.L.P problems – cutting planes – remarks on cutting plane methods – branch and bound method – examples –general description – the 0 – 1 variable.

(Chapter 6; sections: 6.1 – 6.10 of text – 1)

Module 3: GOAL PROGRAMMING , FLOW AND POTENTIALS IN NETWORKS (15 hours)

Goal programming. Graphs- definitions and notation – minimum path problem – spanning tree of minimum length – problem of minimum potential difference – scheduling of sequential activities – maximum flow problem – duality in the maximum flow problem – generalized problem of maximum flow.
(Chapter – 5 & 7 Sections 5.9 & 7.1 to 7.9, 7.15 of text – 1)

Module 4: NON- LINEAR PROGRAMMING (25 hours)

Basic concepts – Taylor's series expansion – Fibonacci Search - golden section search– Hooke and Jeeves search algorithm – gradient projection search – Lagrange multipliers – equality constraint optimization, constrained derivatives – non-linear optimization: Kuhn-Tucker conditions – complimentary Pivot algorithms.

(Chapter 11; Sections: 11.1 – 11.7, 11.9- 11.11 of text – 2**)**

References

1. Rao, Optimization Theory and Applications, 2nd edition, New Age International Pvt.

2. J.K. Sharma, Operations Research: Theory and Applications, Third edition, Macmillan India Ltd.

3. Hamdy A. Thaha, 3.Operations Research – An Introduction, 6th edition, Prentice Hall of India Pvt.Ltd.

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five** **Questions**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

SEMESTER II

COURSE: 20P2MATT06: BASIC TOPOLOGY

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Assimilate the concept of Topological spaces, base and subbase.
CO2: Understand the concept of continuity and quotient spaces.
CO3: Understand the concept of local connectedness, path connected and local connectedness.
CO4: Assimilate the idea of separation axioms.

Text Book: K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, 1984.

Module 1: **(21 hours)**

Definition of a topological space – examples of topological spaces, bases and sub bases – sub spaces. Basic concepts: closed sets and closure – neighborhood, interior and accumulation points (Chapter 4 Section – 1, 2, 3, 4 - Chapter 5 Section -. 1 and 2 of the text. 5.2.11 &5.2.12excluded.)

Module 2: **(18 hours**)

Continuity and related concepts: making functions continuous, quotient spaces. Spaces with special properties: Smallness condition on a space

(Chapter 5. Section. 3 and 4 of the text, 5.3.2(4) excluded) (Chapter 6 Sec. 1 of the text)

Module 3: **(18 hours)**

Connectedness: Local connectedness and paths

(Chapter 6 Section. 2 & 3 ofthetext)

Module 4: **(18 hours)**

Separation axioms: Hierarchy of separation axioms – compactness and separation axioms (Chapter – 7 Section 1 & 2 of the text)

(2.13 to 2.16 ofsection.2 excluded)

References:-

1. Munkres J.R, Topology-A First Course, Prentice Hall of India Pvt. Ltd., New Delhi,2000
2. J.L Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
3. Stephen Willard, General Topology,Addison-Wesley.
4. Dugundji, Topology, Universal Book Stall, NewDelhi.
5. George F Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company,1963.

Question paper Pattern

Module	**Part A** **(2 Marks Question)** **Answer any five Questions**	**Part B** **(5 Marks Question)** **Answer any five**	**Part C** **(10 Marks Question)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P2MATT07: COMPLEX ANALYSIS

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Analyze analytic functions, Power series and Mobius Transformations.

CO2: Determine power series for analytic functions and its zeros. The index of a closed curve, Cauchy's theorem and Cauchy's integral formula, The Homotopic version of Cauchy's theorem and simple connectivity.

CO3: Interpret counting zeros, the open mapping theorem, Goursat's Theorem, classification of singularities, residues and the Argument Principle.

CO4: Understand Maximum Modulus theorem, maximum principle, Schwarz's lemma, convex functions and Hadmard's Three Circles Theorem.

Text: John B. Conway, Functions of One Variable, Second Edition.

Module 1: **(20 hours)**

Analytic functions, Power series, Analytic functions as mappings, Mobius Transformations. (Chapter 3 of the text)

Module 2: Power series representation of analytic functions, Zeros of an analytic function. The index of a closed curve, Cauchy's theorem and Cauchy's integral formula, The Homotopic version of Cauchy's theorem and simple connectivity

(Chapter 4 – Sections 4.2 – 4.6 of the text.) **(20hours)**

Module 3: Counting zeros, The open mapping theorem, Goursat's Theorem, Classification of singularities, Residues , The Argument Principle.

(Chapter 4 – Sections 7 and 8 of the text) **(25hours)**

Module 4: The Maximum Modulus theorem, The maximum principle, Schwarz's lemma, Convex functions and Hadmard's Three Circles Theorem.

(Chapter 6 – Sections 1 - 3 of the text **)** **(25 hours)**

References:

1.Chaudhary. B, The elements of Complex Analysis, WileyEastern.
2.Cartan. H (1973), Elementary theory of Analytic functions of one or several variable, AddisonWesley.
3.Lang. S, Complex Analysis,Springer.
4.H.A. Priestly, Introduction to Complex Analysis, Clarendon press, Oxford,1990.

Question Paper Pattern

Module	**Part A** **(2 Marks Question)** **Answer any 5** **Questions**	**Part B** **(5 Marks** **Question)** **Answer any five**	**Part C** **(10 Marks Question)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P2MATT08: GRAPH THEORY

Hours perweek:5 **Total Credits:4**

Course Outcomes

CO1: Understand basic concepts, sub graphs, degrees of vertices. Paths and connectedness, automorphism of a simple graph, line graphs, basic concepts and tournaments.

CO2: Comprehend connectivity vertex cuts and edge cuts. Connectivity and edge connectivity,blocks. Certain definitions and simple properties, counting the number of spanning trees and Cayley's formula.

CO3: Analyze vertex and edge independent Sets, Eulerian Graphs, Hamiltonian Graphs, Vertex Coloring and certain definitions.

CO4: Understand edge coloring and planarity: certain definitions and properties, dual of a plane graph. The four color theorem and the Heawood five color theorem

Text: R. Balakrishnan and K. Ranganathan, A Text book of Graph Theory, Springer

Module: -1 **(18hours)**

Basic concepts. sub graphs, degrees of vertices. Paths and connectedness, automorphism of a simple graph, line graphs, basic concepts and tournaments.

Chapter 1 (Sections 1.1 to 1.5 and 1.6 (Up to 1.6.3))

Chapter 2 (Sections 2.1 and 2.2)

Module:- 2 **(17 hours)**

Connectivity Vertex cuts and edge cuts. Connectivity and edge connectivity, blocks.

Definition, characterization and simple properties, centres and centroids, counting the number of spanning trees, Cayley's formula.

Chapter 3 (Sections 3.1 to 3.3)
Chapter 4 (Sections 4.1 to 4.4)

Module:- 3 **(20 hours)**

Independent Sets, Eulerian Graphs; Hamiltonian Graphs and Vertex Colouring, Vertex independent sets and vertex coverings. edge independent sets, Eulerian graphs, Hamiltonian graphs, vertex colourings, critical graphs, triangle free graphs.

Chapter 5 (Sections 5.1 and 5.2)

Chapter 6 (Sections 6.1 and 6.2)

Chapter 7 (Sections 7.1 to 7.3)

Module:- 4 : **(20 hours)**

Edge colouring and planarity- Edge colouring of graphs, planar and non planar graphs, Euler formula and its consequences, K5 and K3,3 are non planar graphs, dual of a plane graph. The four colour theorem and the Heawood five colour theorem.

Chapter 7 (Section 7.4 .1 to 7.4.4),
Chapter 8 (Sections 8.1 to 8.5 of the text**)**

References:

1. John Clark and Derek Allan Holton, A First Look at Graph Theory, Alliedpublishers
2. Douglas B West, Introduction to Graph Theory, Prentice Hall ofIndia
3. F.Harary, Graph Theory, Addison-Wesley, 1969

Question paper pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five** **Questions**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P2MATT09: NUMBER THEORY

Hours per week: 5 **Total Credits: 4**

Course Outcomes

CO1: Got introduced to Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields.

CO2: Analyze Trivial Factorizations, Factorization into Irreducibles, particular examples,prime factorization and Euclidean Domains and quadratic fields.

CO3: Understand Prime Factorization of Ideals, the Norm of an Ideal, Nonunique Factorization of Cyclotomic Fields. Lattices, The Quotient Torus, Minkowski theorem, The Two-squares theorem.

CO4: Perceive Fermat theorem, Polynomial congruence modulo, Lagrange's theorem and its applications, simultaneous linear congruence, the Chinese reminder theorem.

Text Book:

1. Algebraic Number Theory and Fermat's Last Theorem, Ian Stewart and David Tall, ThirdEdition

2. Introduction to Analytic Number Theory, Tom M Apostol, Springer International Student Edition.

Module-1 **(20 hours)**

Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields. [Chapter1, Sections 1.4 to 1.6; Chapter 2, Sections 2.1 to 2.6; Chapter 3, Sections 3.1 and 3.2 from the text-1]

Module 2 **(20 hours)**

Historical Background, Trivial Factorizations, Factorization into Irreducibles, Examples of Non-Unique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic Fields. (Chapter 4 – Sections 4.1 to 4.7 of text Text-1)

Module 3 **(20 hours)**

Prime Factorization of Ideals, the Norm of an Ideal, Nonunique Factorization of Cyclotomic Fields. Lattices, The Quotient Torus, Minkowski theorem, The Two-squares theorem

(Chapter 5-Sections 5.1 to 5.4 , chapter-6, chapter-7 of Text 1)

Module 4 **(15 hours)**

Fermat theorem, Polynomial congruences modulo, Lagrange's theorem, applications of Lagrange's theorem, simultaneous linear congruences, the Chinese reminder theorem. (Chapter 5, Sections 5.1 to 5.7 of Text-2)

References:

1. Hardy G.H and Wright E.M, Introduction to the Theory of numbers, Oxford, 1981
2. Leveque W.J, Topics in Number Theory, Addison Wesley, 1961.
3. J.P Serre, A Course in Arithmetic, GTM Vol. 7, Springer-Verlag, 1973
4. D Marcus, Number Fields (Springer-Verlag, New York-Heidelberg)

Question paper pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five** **Questions**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P2MATT10: MEASURE THEORY AND INTEGRATION

Hours per week: 5 **Total Credits: 4**

Course Outcomes

CO1: Understanding the concept of Lebesgue measure, measurable and non-measurable sets and measurable functions.
CO2: Determine Lebesgue integral and integral of bounded function over a set of finite measures, the integral of a non-negative function, the general Lebesgue integral
CO3: Analyze measure spaces measurable functions, general convergence theorems and extension theorems.
CO4: Understandmeasurability in a product space, the product measure and Fubini's theorem.

Text 1: H.L. Royden, Real Analysis, Third edition, Prentice Hall of India Private Limited.

Text 2: G. de Barra, Measure Theory and Integration, New Age International (P) Linnilect Publishers.

Pre-requisites: Algebras of sets, the axiom of choice and infinite direct products, open and closed sets of real numbers.

(Chapter 1 - section 4, 5 Chapter 2 - section 5 ofText1).

(5 hours)

(No questions shall be asked from this section)

Module 1: **(15hours)**

Lebesgue measure: introduction, outer measure, measurable sets and Lebesgue measure, & non-measurable sets, measurable functions. (Chapter -3 sections 1 to 6)

Module 2: **(20 hours)**

Lebesgue integral: the Riemann integral, The Lebesgue integral of a bounded function over a set of finite measures, the integral of a non-negative function, the general Lebesgue integral.

(Chapter 4 - Sec. 1 – 4. ofText1)

Module 3: **(20 hours)**

Measure and integration: measure spaces, measurable functions, Integration, general convergence theorems, signed measures, outer measure and measurability, the extension theorem.

(Chapter 11 - Sec. 1 to 5 of Text 1Chapter 12 - Sec. 1& 2 ofText1)

Module 4: **(15 hours)**

Measurability in a product space, the product measure and Fubini's theorem.

(Chapter 10 - Sec. 10.1& 10.2 of Text)

References:-

1.Halmos P.R, Measure Theory, D.van NostrandCo.
2.P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Ltd., New Delhi, 1986(Reprint 2000).

3.R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc New York,1966.
4.Inder K Rana, An Introduction to Measure and Integration, Narosa Publishing House

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any 5** **Questions**	**Part B** **(5 Marks** **Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

SEMESTER III

COURSE: 20P3MATT11: PARTIAL DIFFERENTIALEQUATIONS

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Understand orthogonal trajectories of a system of curves on a surface. Pfaffian differential forms and equations. Solution of Pfaffian differential equations in three variables.

CO2: Analyze nonlinear partial differential equation of the first order, Compatible systems of first order equations. Charpits Method. Special types of first order equations, Jacobi's method.

CO3: Comprehend linear partial differential equations with constant coefficients. Equations with variable coefficients, Reduction to Canonical form, Cauchy's problem of second order pde, Characteristic curves of second order equations.

CO4: Studying the solution of linear Hyperbolic equations, Monge's method. Separation of variables, Elementary solutions of Laplace equation, Dirichlet problem for a rectangle, The Neumann problem for a rectangle.

Text Book 1:Ordinary and Partial Differential Equations, Dr. M.D. RaiSinghania
Text Book 2: K Sankara Rao, Introduction to Partial Differential Equations, Prentice-Hall of India

Module:-1. **(21 hours)**

Methods of s olutions of dx/P = dy/Q = dz/R. Orthogonal trajectories of a system of curves on a surface. Pfaffian differential forms and equations. Solution of Pfaffian differential equations in three variables, Origin and classification of first order partial differential equation, Cauchy's problem for first order equation, Linear pde of first order, Integral surfaces passing through a given curve, Surfaces orthogonal to a given system of surfaces, Linear pde of n independent variables. (Part II 2.8 -2.12 , 3.1 – 3.13 , Part III 1.1- 1.11, 2.1- 2.20 of the text)

Module:-2. **(21 hours)**

Nonlinear partial differential equation of the first order, Compatible systems of first order equations. Charpits Method. Special types of first order equations, Jacobi's method.

(Part III 3.1 - 3.22 of the text)

Module:-3 **(17 hours)**

Linear partial differential equations with constant coefficients. Equations with variable coefficients, Reduction to Canonical form, Cauchy's problem of second order pde, Characteristic curves of second order equations .

(4.1- 4.13, 6.1-6.4, 8 – 8.5)

Module:-4. **(16 hours)**

The solution of linear Hyperbolic equations, Monge's method .Seperation of variables, Elementary solutions of Laplace equation, Dirichlet problem for a rectangle, The Neumann problem for a rectangle(8.6- 8.7,8.12, 9.1-9.6)
Text -2 (Chapter 2 –sections 2.5 ,2.6,2.7)

References:

1. Phoolan Prasad and RenukaRavindran, Partial differential Equations, NewAge International (p) Limited
2. E.T Copson , Partial differential equations , S .Chand &Co

Question paper pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five** **Questions**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P3MATT12: FUNCTIONAL ANALYSIS

Hours per week: 5 **Total Credits: 4**

Course Outcomes

CO1: Understand Normed Linear Spaces , Continuity of Linear Maps ,Linear Homeomorphism , Equivalent Norms ,F'Riesz lemma ,Bounded Linear Maps and Bounded Linear Functionals , Dual space– Examples , Hahn Banach Theorem , Hahn Banach separation theorem , Hahn B

CO2: Analyze Completeness of a norm, Banach space, convergence and absolute convergence in a normed linear space, Schauder basis, Uniform boundedness principle, Banach-Steinhaus theorem, Closed graph theorem, Projections on closed subspaces.

CO3: Comprehend Open mapping theorem, spectrum of a bounded operator, Eigen value and Eigen vector, Eigen spectrum, Gelfand- Mazur theorem, Spectral radius formula.

CO4: Studying Space of Bounded linear functionals, Dual of normed linear space.

TEXT BOOK : Function Analysis , **B V LIMAYE**,Wiley Eastern Limited 6th reprint , March1991

Pre requisites: Linear spaces, Linear maps, Metric space ,Compact sets , Heine Borel theorem , Continuous functions ,Tietze's extension theorem ,Lebesgue integrable functions.

Module1: **(20hours)**

Normed Linear Spaces , Examples ,Continuity of Linear Maps ,Linear Homeomorphism , Equivalent Norms ,F'Riesz lemma ,Bounded Linear Maps and Bounded Linear Functionals , Dual space– Examples , Hahn Banach Theorem , Hahn Banach separation theorem , Hahn Banach extension theorem.

Chapter2:sections 5 -5.4, 6 - 6.12 ,7 - 7.9 .

Module 2: **(20 hours)**

Completeness of a norm ,Banach space , convergence and absolute convergence in a normed linear space, Schauder basis ,Uniform boundedness principle , Banach-Steinhaus theorem , Closed graph theorem , Projections on closed subspaces.

Chapter2:Sections –8 - 8.7

Chapter 3 : Sections - 9 - 9.5, 10 - 10.**7**

Module 3: **(18 hours)**

Open mapping theorem, spectrum of a bounded operator , Eigen value and Eigen vector, Eigen spectrum ,Gelfand- Mazur theorem , Spectral radius formula

Chapter 3: Sections11-11.3, 12 - 12.9

MODULE – 4 **(17 hours)**

Space of Bounded linear functionals , Dual of an nls , Examples , Second dual , Transpose of a Bounded linear map ,Duals of $L^p[a, b]$ and $C[a, b]$

Chapter4 :13 - 13.12,14 - 14.3.

REFERENCES:

1. Introductory Functional Analysis, KREYSZIG, Wiley classic library Edition

2. SIMMONS.G.FM, Introduction to Topology and modern analysis McGrow- hill ,1963 New York

3. WALTER RUDIN, Functional Analysis, TMH Edition, 1974

4. M. THAMBAN NAIR, Functional Analysis A First course, Prentice-Hall of India Pvt.Ltd, 2008

Question Paper Pattern

Module	**Part A** **(2Marks Questions)** **Answer any5** **Questions**	**Part B** **(5 Marks** **Questions)** **Answer any four**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	3	2
II	3	2	2
III	2	2	2
IV	1	1	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P3MATT13: ADVANCED TOPOLOGY

Hours per week: 5 **Total Credits: 4**

Course Outcomes

CO1: UnderstandUrysohn Characterization of Normality ,Tietze Characterization of

CO2: Normality, Products and co-products.

CO3: Analyze embedding and Metrisation, Evaluation Functions in to Products,embedding

Lemma and Tychnoff Embedding, The Urysohn Metrisation Theorem.

CO4: Assimilate convergence and related properties of nets and filters.

CO5:Understand compactness, variations of compactness.

Text Book: K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.

Module 1:
UrysohnCharacterisation of Normality – Tietze Characterisation of
Normality. (Chapter 7 Section-.3 and 4 of the text.) (Proof of 3.4, 4.4, and 4.5 excluded)
Products and co-products: Cartesian products of families of sets– Product Topology – Productive properties. (Chapter 8 Section. 1, 2 & 3 of the text) (proof of 1.6 &1.7 excluded)
(21 hours)

Module 2:

Embedding and Metrisation – Evaluation Functions in to Products,
Embedding Lemma and Tychnoff Embedding, TheUrysohnMetrisation Theorem.
(Chapter 9. Sec. 1, 2 & 3 of the text) **(12 hours)**

Module 3:

Nets and Filters: Definition and Convergence of Nets, Topology and
Convergence of Nets, Filters and their Convergence, Ultra filters and Compactness.
(Chapter – 10 Sections -1, 2, 3 & 4 of the text) **(21hours)**

Module 4:

Compactness: Variations of compactness – local compactness –
compactification. Chapter 11,Section 1 (Proof of theorem 1.4 & 1.12 excluded),
Section 3 Section 4(from 4.1 to 4.7) of the text **(21hours**)

References:-

1. Munkres J.R, Topology-A First Course, Prentice Hall of India Pvt. Ltd., NewDelhi,2000.
2. J.L Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
3. Stephen Willard, General Topology,Addison-Wesley.
4. Dugundji, Topology, Universal Book Stall, NewDelhi.
5. George F Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company,1963.

Question Paper Pattern

Module	Part A (2 Marks Questions) Answer any five	Part B (5 Marks Questions) Answer any five	Part C (10 Marks Questions) Answer one from each module
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P3MATT14: ADVANCED COMPLEX ANALYSIS

Hours per week: 5 **Total Credits:4**

Course Outcomes

CO1: Understand the space of functions, Riemann mapping theorem and Weierstrass factorization theorem.

CO2: Analyze Runge's Theorem, Simple connectedness, Mittag Leffler's theorem, Analytic continuation and Riemann surfaces, Schwartz Reflection Principle, Analytic continuation along a path, Mondromy theorem.

CO3: Interpret Harmonic functions, Basic properties of harmonic functions and Harmonic functions on the disk.

CO4: Perceive entire functions, Jensen's formula, the genus and order of an entire function, Hadamard Factorization theorem.

Text Book: Conway .J.B, Functions of one Complex variable, Second Edition.

Module 1: Compactness and convergence in the space of analytic functions

The space of continuous functions, 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 Sections 1,2,4-8 of the text) **(25hours)**

Module 2:Runge's Theorem

Runge's Theorem, Simple connectedness, MittagLeffler's theorem , Analytic continuation and Riemann surfaces , Schwartz Reflection Principle, Analytic continuation along a path, Mondromy theorem(without proof)

(Chapter 8 - Sections 1-3, Chapter 9 Sections 1-3 of the text) **(23hours)**

Module 3:

Harmonic functions, Basic properties of harmonic functions, Harmonic functions on the disk

(Chapter 10 Section 1 - 2 of the text) **(17 hours)**

Module 4:

Entire functions, Jensen's formula, The genus and order of an entire function, Hadamard Factorization theorem (without proof) (Chapter 11 Sections 1 - 3 of the text) **(10 hours)**

References:

1. Chaudhary. B, The elements of Complex Analysis, WileyEastern.
2. Cartan. H (1973), Elementary theory of Analytic functions of one or several variable, Addison Wesley.
3. Lang. S, Complex Analysis,Springer.
4. H.A. Priestly, Introduction to Complex Analysis, Clarendon press, Oxford,1990
5. Lars V. Ahlfors, Complex Analysis, Third edition, McGraw Hill Internationals

Question Paper Pattern

Module	**Part A** **(2 Marks Questions) Answer any five Questions**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer any four**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P3MATT15: MULTIVARIATE CALCULUS AND INTEGRAL TRANSFORMS

Hours per week: 5 **Total Credits: 4**

Course Outcomes

CO1: Understand the Weirstrass theorem,other forms of Fourier series, the Fourier integral theorem, the exponential form of the Fourier integral theorem, integral transforms and convolutions, the convolution theorem for Fourier transforms.

CO2: Analyze Multivariable Differential Calculus The directional derivative, directional derivatives and continuity, the total derivative, the total derivative expressed in terms of partial derivatives, An application of complex- valued functions, the matrix o

CO3: Interpret Implicit functions and extremum problems, the mean value theorem for differentiable functions, a sufficient condition for differentiability.

CO4: Studying Integration of Differential Forms, primitive mappings, partitions of unity, change of variables, differential forms, Stokes theorem

Text 1: Tom APOSTOL, Mathematical Analysis, Second edition, Narosa Publishing House.

Text 2: WALTER RUDIN, Principles of Mathematical Analysis, Third edition – International Student Edition.

Module 1:

TheWeirstrasstheorem,otherformsofFourierseries,theFourierintegraltheorem,theexponentialformofthe Fourierintegraltheorem,integraltransformsandconvolutions,theconvolutiontheoremforFouriertransforms. (Chapter 11 Sections 11.15 to 11.21 ofText1) **(16 hours)**

Module 2:

Multivariable Differential Calculus The directional derivative, directional derivatives and continuity, the total derivative, the total derivative expressed in terms of partial derivatives, An application of complex- valued functions, the matrix of a linear function, the Jacobian matrix, the chain rate matrix form of the chain rule. (Chapter 12 Sections.12.1to12.10ofText1) **(17hours.)**

Module 3:

Implicit functions and extremum problems, the mean value theorem for differentiable functions, a sufficient condition for differentiability, a sufficient condition for equality of mixed partial

derivatives, functions with non-zero Jacobian determinant, the inverse function theorem (without proof), the implicit function theorem (without proof), extrema of real- valued functions of one variable, extrema of real- valued functions of several variables. Chapter 12 Sections-. 12.11 to 12.13. of Text 1 Chapter 13 Sections-. 13.1 to 13.6 of Text 1

(21 hours.)

Module 4:

Integration of Differential Forms Integration, primitive mappings, partitions of unity, change of variables, differential forms, Stokes theorem (without proof)

Chapter 10 Sections. 10.1 to 10.25, 10.33 ofText2 **(21 hours.)**

References:- 1. LimayeBalmohan Vishnu, Multivariate Analysis,Springer.

2. SatishShirali and Harikrishnan, Multivariable Analysis, Springer

Question Paper Pattern

Module	**Part A** **{2 Marks Questions)** **Answer any5**	**Part B** **(5 Marks** **Questions)** **Answer any 5**	**Part C** **(10 Marks Questios)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

SEMESTER –IV

COURSE: 20P4MATT16- ADVANCED FUNCTIONAL ANALYSIS

Hours perweek:5 **Total Credits:4**

Course Outcomes

CO1: Understanding Weak and Weak-*convergence,Reflexive space, Hell's theorem,Eberlein's theorem, Jame's theorem, Compact Linear maps, Examples, Spectrum of a Compact operator.

CO2: Analyze Inner product spaces , Examples ,Schwarz's Inequality, Properties, Pythagoras theorem ,Gram Schmidt Orthonormalization ,Bessel inequality, Orthonormal basis

CO3: Assimilate Projection Theorem, Riesz representation Theorem ,Unique Hahn – Banach extension theorem, Bounded Operators on a Hilbert space, SesquiLinear Functional, Adjoint of a Bounded operator on a Hilbert Space , Properties.

CO4: Developing ideas of Normal, Unitary and Self Adjoint Operators, Spectral Analysis of Self adjoint Operators, Finite Dimensional Spectral Theorem, Spectral theorem for Compact Self Adjoint Operators.

Text Book: Functional Analysis, B V Limaye, Wiley Eastern limited 6th Reprint, March 1991.

Module I

Weak and Weak-* convergence,Reflexive space , Hell's theorem , Eberlein's theorem, Jame's theorem, Compact Linear maps, Examples, Spectrum of a Compact operator.

Chapter 4 : Sections 15 -15.7 ,16 - 16.5.

Chapter5 : Sections 17 - 17.5 - 18.5.

(15 hours)

Module 2

Inner product spaces , Examples , polarization identity ,Parallelogram law ,Schwarz's Inequality, Properties, Hilbert spaces , Orthonormal Sets , Pythagoras theorem –,Gram Schmidt Orthonormalization ,Bessel inequality, Orthonormal basis

Chapter6 : Sections 21 - 21.7, 22 - 22.13

(20 hours)

Module 3

Projection Theorem , Riesz representation Theorem , Examples, Unique Hahn – Banach extension theorem ,Examples , Bounded Operators on a Hilbert space, Examples, SesquiLinear Functional,Adjoint of a Bounded operator on a Hilbert Space , Examples, Properties.**Chapter6 :** Sections 24 - 24.7.

Chapter7: Sections25 - 25.7.

(20 hours)

Module 4

Normal , Unitary and Self Adjoint Operators , Examples, Spectrum and numerical range ,Spectral Analysis of Self adjoint Operators, Orthogonal Projections, Finite Dimensional Spectral Theorem, Spectral theorem for Compact Self Adjoint Operators.

Chapter7 : Sections (26 - 26. 4, 27 - 27.13, 29 - 29.9**)** **(17 hours)**

References

1. Simmons, G.F, Introduction to Topology and Modern Analysis, McGraw –Hill, New York1963.
2. Erwin Kreyszig, Introductory Functional Analysis with applications, John Wiley and sons, New York

3. Siddiqi, A.H, Functional Analysis with Applications, Tata McGraw –Hill, New Delhi :1989

4. Somasundaram. D, Functional Analysis, S.Viswanathan Pvt. Ltd, Madras,1994

5. Vasistha, A.R and Sharma I.N, Functional analysis, Krishnan Prakasan Media (P) Ltd(1996)

6.M. Thamban Nair, Functional Analysis, A First Course, Prentice – Hall of India Pvt. Ltd, . 2008 6.Walter Rudin, Functional Analysis, TMH Edition,1974.

Question paper Pattern

Module	Part A (2 Marks Questions) Answer any five Questions	Part B (5 Marks Questions Answer any five	Part C (10 Marks Questions) Answer one from each module
1	1	2	2
2	3	2	2
3	2	3	2
4	2	1	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P4MATT17EL: DIFFERENTIAL GEOMETRY

Hours per week: 5 **Total Credits: 4**

Course Outcomes

CO1: Perceive ideas of Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces, orientation

CO2: Understand the fundamentals of The Gauss map, geodesics, Parallel transport

CO3: Assimilate the ideas of the Weingarten map, curvature of plane curves, Arc length and line integrals

CO4: Developing skills related to Curvature of surfaces

Text Book: John A. Thorpe, Elementary Topics in Differential Geometry

Module 1: Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces, orientation. (Chapters 1 to 5 of the text**)** **(15hours)**

Module 2: The Gauss map, geodesics, Parallel transport, (Chapters 6, 7 & 8 of the text)

(20 hours)

Module 3: The Weingarten map, curvature of plane curves, Arc length and line integrals

(Chapters 9, 10 & 11 of the text) **(20hours)**

Module 4: Curvature of surfaces

(Chapters 12 of the text). **(20 hours)**

References:- 1. Serge Lang, DifferentialManifolds

2. I.M. Siger, J.A Thorpe, Lecture notes on Elementary topology and Geometry,Springer

(1967)

3.S. Sternberg, Lectures on Differential Geometry, Prentice-Hall,1964.

4.M. DoCarmo, Differential Geometry of curves andsurfaces.

5.Goursat, Mathematical Analysis, Vol – 1(last twochapters)

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any5**	**Part B** **(5 Marks Questions)** **Answer any5**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P4MATTEL18- PROBABILITY THEORY

Hours perweek: 5 **Total Credits:3**

Course Outcomes

CO1: Assimilate the idea of Algebra of sets, Fields, Sigma fields, Inverse function, Measurable functions, Random variables, Induced sigma fields, Limits of random variables.
CO2: Understand the concept of Probability Space,
Extension of Probability measure and Other measures.
CO3: Perceive different named theorems
CO4: Understand the concept of Convergence of sequence of random variables – Convergence in law, Convergence in probability and certain named theorem

Text 1: V.K (2001) An Introduction to Probability and Statistics, 2ndEdn, Wiley India (P) Ltd, New Delhi.
Text 2: Bhat B.R (1999) Modern Probability Theory , 3rdEdn, New Age International (P) Ltd, New Delhi.

Module 1: Random variables: Algebra of sets, Fields, Sigma fields, Inverse function, Measurable functions, Random variables, Induced sigma fields, Limits of random variables.
(Text 2 : Unit- 1) **(18 hours)**

Module 2: Probability Space,Defnitions of probability, Properties, Discrete Probability space, general probability space, Induced probability space, Extension of Probability measure,Other measures, Moment inequalities – Markov's inequality, Chebychev- Bienayme's inequality, Lyapunov's inequality.
(Text 2 :Unit-3)
(Text 1 : Chapters 2& 3 ,Text 2 : Chapter 3**)** **(20 hours)**

Module 3: Multiple random variable, Independence of random variables, Covariance and Correlation and moments, Addition and Multiplication theorems on expectation, Cr inequality, Holder's inequality, Cauchy- Schwartz's inequality, Jensen's inequality, Minkowski's inequality, Conditional expectation.

Text Book 1 :Sections 4.2 to 4.3 (till example 6), 4.5 (till theorem 6 including its Corollary's 1 and 2, 4.6.
Text Book 2 :Section 5.3 (c) and (d). **(20 hours)**

Module 4: Convergence of sequence of random variables – Convergence in law, Convergence in probability, Convergence in rth mean, Convergence almost surely. Weak Law of Large Numbers-Kinchine's Weak Law of Large Numbers, Strong Law of Large Numbers-Kolmogrov strong law of large numbers, Central Limit Theorem- Lindberg- Levy form and Liapunov's form of Central Limit Theorem

Text Book 1 : Section 6.2 (till Theorem 12**)** **(17 hours**)

References:

1)S.C Gupta and V.K Kapoor (2002) Fundamentals of Mathematical Statistics, 11thEdn, Sultan Chand & Sons, New Delhi.

2) Billingsley, P. (1986) Probability and Measure, Second Edition, John Wiley

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any5**	**Part B** **(5 Marks Questions)** **Answer any 5**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P4MATTEL19- Numerical Analysis with Python3

Hours per week: 5 **Total Credits:3**

Course Outcomes

CO1: Analyze Defining Symbols and Symbolic Operations, Working with Expressions, Solving Equations and Plotting Using SymPy, problems on factor finder, summing a series and solving single variable inequalities

CO2: Understand the relevance of finding the limit and derivative of functions. The continuity of a function at a point, curve length and area between two curves.

CO3: Comprehend interpolation and Curve Fitting, Lagrange's Method, Newton's Method. Determine roots of equations by bisection method and Newton-Raphson method.

CO4: Perceive Gauss Elimination Method, Doolittle's Decomposition method, Numerical Integration, Newton-Cotes Formulas, Trapezoidal rule, Simpson's rule and Simpson's 3/8 rule.

Text 1 :Jason R Brigs , Python for kids – a playful introduction to programming, No Starch Press

Text 2 : Amit Saha, Doing Math with Python, No Starch Press, 2015.

Text 3 :JaanKiusalaas, Numerical Methods in Engineering with Python3, Cambridge University Press

Though any distribution of Python 3 software can be used for practical sessions, to avoid difficulty in getting and installing required modules like numpy, scipyetc, and for uniformity, the Python3 package Anaconda 2018.x (https://www.anaconda.com/distribution/#downloadsection) may be installed and used for the practical sessions. However, a brief introduction on how to use Python IDLE 3 also should be given.

BASICS OF PYTHON

Before going into mathematics programming part, an introduction to Python should be given.

<u>No questions should be included in the end semester examination from this unit</u>. Internal examinations may test the knowledge of concepts from this section.

From Text 1, Chapter 2 full – calculations and variables,

Chapter 3 – creating strings, lists are more powerful than strings, tuples,

Chapter 5- If statements, if-then-else statements, if and elif statements, combining conditions, the difference between strings and numbers,

Chapter 6 – using for loops, while we are talking about looping,

Chapter 7 – using functions, parts of a function, using modules

Chapter 9 – The functions abs, float, int, len, max, min, range, sum

From Text 2 Chapter 1 - section complex numbers

Module I : Defining Symbols and Symbolic Operations, Working with Expressions, Solving Equations and Plotting Using SymPy, problems on factor finder, summing a series and solving single variable inequalities

Chapter 4 - From text 2

Module II : Finding the limit of functions, finding the derivative of functions, higher-order derivatives and finding the maxima and minima and finding the integrals of functions are to be done. in the section programming challenges, the following problems - verify the continuity of a function at a point, area between two curves and finding the length of a curve

Chapter 7 from text 2

Module III : Interpolation and Curve Fitting - Polynomial Interpolation - Lagrange's Method, Newton's Method and Limitations of Polynomial Interpolation, Roots of Equations - Method of Bisection and Newton-Raphson Method.

Chapter 3, sections 3.1, 3.2 Chapter 4, sections 4.1, 4.3, 4.5 From Text 3

Module IV : Gauss Elimination Method (excluding Multiple Sets of Equations), Doolittle's Decomposition Method only from LU Decomposition Methods Numerical Integration, Newton-Cotes Formulas, Trapezoidal rule, Simpson's rule and Simpson's 3/8 rule.

Chapter 2, sections 2.2, 2.3 , Chapter 6, sections 6.1, 6.2 From Text 3

1. Instead of assignments, a practical record book should be maintained by the students. Atleast 15 programmes should be included in this record book.

2. Internal assessment examinations should be conducted as practical lab examinations by the faculty handling the paper.

3. End semester examination should focus on questions including concepts from theory and programming. However, more importance should be given to theory in the end semester examinations as internal examinations will be giving more focus on programming sessions

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five** **Questions**	**Part B** **(5 Marks** **Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P4MATTEL20- THEORY OF WAVELETS

Hours per week: 5 **Total Credits: 3**

Course Outcomes

CO1: Comprehend the basics of wavelet theory.

CO2: Discover the areas in which theory of wavelets is applicable.

CO3: Assimilate the role of linear algebra in wavelet theory complete orthonormal sets in Hilbert Spaces.

CO4: Developing basic ideas of Haar Wavelets, Shannon Wavelets and Daubechies's D6 Wavelets.

Text Book: Michael W. Frazier, An introduction to Wavelets through Linear Algebra, Springer- Verlag, 2000.

Pre-requisites:- Linear Algebra, Discrete Fourier Transforms, Elementary Hilbert Space theorem. (No questions shall be asked from these sections.)

Module – 1:- Construction of Wavelets on Z_N: The First Stage.

(Chapter – 3 Section 3.1 of the text) **(18 hours)**

Module – 2:-Construction of Wavelets on Z_N: The Iteration Step, Examples – Haar, Shannon and Daubechies). (Chapter – 3 Section 3.2 & 3.3 ofthe text**) (18hours)**

Module – 3:- l2 (Z), Complete Orthonormal sets in Hilbert Spaces, L2 [-π , π] and Fourier Series.

(Chapter – 4 Section 4.1, 4.2 & 4.3 of the text) **(19 hours)**

Module – 4:- The Fourier Transform and Convolution on l2 (Z), First-stage Wavelets on Z, The Iteration step for Wave lets on Z, Examples- Haar and Daubechies.

(Chapter – 4 Section 4.4, 4.5, 4.6 & 4.7 of the text) **(20hours)**

Reference

1. Mayer, Wavelets and Operators, Cambridge University Press1993

2. Chui, Ann Introduction to Wavelets, Academic Press, Boston,1992

Question Paper Pattern

Module	**Part A** **(1.5 Marks Question) Answer all Questions**	**Part B** **(5 Marks Question)** **Answer any four**	**Part C** **(10 Marks Question)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P4MATTEL21 - ALGEBRAIC TOPOLOGY

Hours perweek:5 **Total Credits:3**

Course Outcomes

CO1: Understand Geometric Complexes , Polyhedra and Simplicial Homology Groups

CO2: Perceive the idea of Pseudomanifolds , the homology groups of Sn and Simplicial Approximation

CO3: Assimilate Fundamental Group.

CO4: Understand the concept of covering space.

Text : Fred H. Croom., Basic Concepts of Algebraic Topology, UTM, Springer Verlag ,NY, 1978.

Module – I Geometric Complexes and Polyhedra: Introduction. Examples, Geometric Complexes and Polyhedra ;Orientation of geometric complexes. Simplicial Homology Groups: Chains, cycles, Boundaries and homology groups, Examples of homology groups; The structure of homology groups; (Chapter 1 Sections 1.1 to 1.4; Chapter 2 Sections 2.1 to 2.3)

(20 Hours)

Module – II Simplicial Homology Groups (Contd.): The Euler Poincare's Theorem; Pseudomanifolds and the homology groups of Sn .Simplicial Approximation: Introduction ; Simplicial approximation ; Induced homomorphisms on the Homology groups; The Brouwer fixed point theorem and related results (Chapter 2 Sections 2.4,2.5; Chapter 3 Sections 3.1 to 3.4 from the text)

(20 Hours)

Module – III The Fundamental Group : Introduction; Homotopic Paths and the Fundamental Group; The Covering Homotopy Property for S1; Examples of Fundamental Groups. (Chapter 4 Sections 4.1 to 4.4 from the text) **(20 Hours)**

Module - IV Covering spaces -Definition and some examples-Basic properties of covering spaces-Classification of covering spaces-Universal covering spaces.(Chapter 5) **(15 Hours)**

References:

(1)Eilenberg S; Steenrod N., Foundations of Algebraic Topology, Princeton Univ. Press, 1952.

(2) S.T. Hu., Homology Theory, Holden-Day, 1965.

(3) MasseyW.S., Algebraic Topology : An Introduction, Springer Verlag NY, 1977.

(4) C.T.C. Wall., A Geometric Introduction to Topology, Addison-Wesley Pub. Co. Reading Mass, 1972.

Question Paper Pattern

Module	**Part A** **(2 Marks Question)** **Answer any five** **Questions**	**Part B** **(5 Marks** **Question)** **Answer any five** **questions**	**Part C** **(10 Marks Question)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 19P4MATTEL22 : INTRODUCTION TO CHAOTIC DYNAMICAL SYSTEMS

Hours perweek:5 **Total Credits:3**

Course Outcomes

CO1: Understand Orbits, Fixed ,Periodic points, Doubling function.

CO2: Perceive the idea of Bifurcation and Quadratic family.

CO3: Assimilate Symbolic Dynamics and Chaotic System.

CO4: Comprehend Fractal

Text Book: Robert L Devaney, A FIRST COURSE IN CHAOTIC DYNAMICAL SYSTEMS THEORY AND EXERIMENTS, CRC PRESS

Module 1: Orbits, Fixed and Periodic points

Iteration, Orbits, Types of Orbits, Other orbits, Doubling function, A fixed point theorem, Attraction and repulsion, Calculus of fixed points, what is true, Periodic points

Chapter 3, Section 3.1 to 3.5 & Chapter 5, Section 5.1 to 5.5

Module 2: Bifurcation and Quadratic family

Dynamics of a quadratic map, The Saddle –Node Bifurcation, The period Doubling Bifurcation, The case $c = -2$, The case $c \leftarrow 2$, The cantor middle third set

Chapter 6: 6.1 to 6.3 and Chapter 7

Module 3: Symbolic Dynamics and Chaos

Itineraries, The sequence space, The shift map, Conjugancy, The properties of a Chaotic system, Other Chaotic system, Sarkovskii's theorem(Statement of theorms Only)

Chapter 9, Chapter 10.1 to 10.2, Chapter 11(statementof theorem only)

Module 4: Fractals

The Chaos game, The cantor set revisited, The Sierpinski Triangle, The Koch Snowflak, Fractal dimension, Iterated function system, Calculus of Complex functions, The Julia set, The squaring function, The Chaotic quadratic function, The Julia set as repellor, The Mandelbrot set.

Chapter 14.1 to 14.7, Chapter 15.4, Chapter 16.1 to 16.2,16.6 and Chapter 17.2

REFERENCE

1. Beardon, A. F., Iteration of rational functions, Springer-Verlag, 1991.
2. Carleson, L. and Gamelin, T. W., Complex dynamics, Springer-Verlag, 1993.
3. Devaney, R. L. et al, Complex dynamical systems, American Mathematical Society, 1994.
4. McMullen, C. T., Complex dynamics and renormalization, Princeton University Press, 1994.

5.Milnor, J., Dynamics in one complex variable, Princeton University Press, 2006

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

COURSE: 20P4MATTEL23: ABSTRACT HARMONIC ANALYSIS

Hours per week: 5 **Total Credits: 3**

Course Outcomes

CO1: Understand topological and locally compact groups, Haar measure. Modular function, convolutions, homogenous spaces, unitary representations, Gelfand-Raikov theorem.

CO2: Perceive Unitary Representations, Representations of a group and its group algebra, functions of positive type.

CO3: Assimilate Dual Group, the Fourier Transform, The Pontrjagin Duality Theorem, Representations of Locally Compact Abelian Groups, Closed Ideals in L1 (G), Spectral Synthesis, The Bohr Compactification.

CO4: Analyze the representations of Compact Groups, The Peter-Weyl Theorem, Fourier Analysis on Compact Groups.

Text Book:

Folland G. B. A *course in Abstract Harmonic Analysis*: *Studies in Advanced mathematics*, CRC press

Module-1

Topological groups, locally compact groups, Haar measure. Modular function, convolutions, homogenous spaces , unitary representations, Gelfand-Raikov theorem [Chapter 2, Sections 2.1 to 2.6] **(20 hours)**

Module 2

Unitary Representations, Representations of a group and its group algebra, Functions of Positive Type, Notes and References (Chapter 3, Sections 3.1-3.4) **(20 hours)**

Module 3

The Dual Group, The Fourier Transform, ThePontrjagin Duality Theorem, Representations of Locally Compact Abelian Groups, Closed Ideals in L^1 (G), Spectral Synthesis, The Bohr Compactification (Chapter 4 – Sections 4.1- 4.7) **(20 hours)**

Module 4

Representations of Compact Groups, The Peter-Weyl Theorem, Fourier Analysis on Compact Groups, (Chapter 5, Sections 5.1-5.4**)** **(15 hours)**

References:

1. **Hewitt E. and Ross K.** ***Abstract Harmonic Analysis, Vol 1,*** **Springer**
2. **Gaal S. A.** ***Linear Analysis and Representation theory*****, Springer**

Question Paper Pattern

Module	**Part A** **(2 Marks Questions)** **Answer any five**	**Part B** **(5 Marks Questions)** **Answer any five**	**Part C** **(10 Marks Questions)** **Answer one from each module**
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 MARKS)	10 Marks	25 Marks	40 Marks

PROJECT: 20P4MATPJ

The M.Sc Mathematics project is an extended piece of independent study and written work. The project will involve an in-depth study of a particular advanced topic in mathematics or statistics.

It will be based around one or more published research papers, as well as advanced textbooks and other resources. Your supervisor will describe an outline of the structure of your project, and suggest some books, papers and other resources you should consult. However, it is expected that you will be proactive

in finding further references and resources, and in coming up with your own ideas for further investigations, examples and results. The Project work is evaluated for 100 marks (25 internal and 75 external).

COMPREHENSIVE VIVA - VOCE: 20P4MATCV

There shall be a Comprehensive viva at the end of Semester IV. The Comprehensive viva voce is intended to assess the students understanding of the subjects that are studied during their course. The Comprehensive viva voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive viva voce.

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