SRI SANKARA ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

ENATHUR, KANCHIPURAM – 631 561

CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF MATHEMATICS

M.SC. DEGREE COURSE IN MATHEMATICS

REGULATIONS

(With effect from the academic year 2015-2016)

1. THE CBCS SYSTEM

All programmes (named after the core subject) mentioned earlier shall be run on **ChoiceBased Credit System (CBCS).** It is an instructional package developed to suit the needs ofstudents to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

2. ELIGIBILITY FOR M.Sc. MATHEMATICS

A candidate who has passed the B.Sc., degree examination in Branch I Mathematics or B.Sc., Applied Sciences of any University accepted by Academic Council of the Autonomous College as equivalent thereto.

3. ELIGIBILITY FOR THE AWARD OF DEGREE

A Candidate shall be eligible for the award of the Degree only if he / she has undergone the prescribed course of study in a Autonomous College for a period of not less than two academic years, passed the examinations of all the Four Semesters prescribed earning **90** credits in Parts-I, II, III, IV & V and fulfilled such conditions as have been prescribed therefore. The parent university will award degrees to the students evaluated and recommended by autonomous colleges. The degree certificates will be in a common format devised by the university. The name of the college will be mentioned in the degree certificate, if so desired. The declaration of results was decided by the examination committee.

4. DURATION

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

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 exclusive of the days for the conduct of semester examinations.

In each semester, Courses are administered in 15 teaching weeks and another 5 weeks are utilized for evaluation and grading purposes. Each week has 30 working hours spread over in a 5 day week. Depending upon the content and specialization, a paper may have 1 to 6 credits. Total number of teaching hours in a semester will be 450 hrs.

5. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMMES

The candidates shall complete the Masters Degree Programmes within 4 years from the date of admission. The term completing the programmes means passing all the prescribed examinations of the programme to become eligible for the degree. No candidate shall be permitted to appear for

the examinations after the prescribed period for completing the programme.

6. MEDIUM OF INSTRUCTION

The medium of instruction shall be English.

7. COURSE OF STUDY

A Master's programme consists of a number of courses (papers). The term Course is used to indicate logical part of a subject matter of the programme. In each of Master's programmes, there will be a prescription of (i) Part –I (Core subjects – Theory, Practicals, Project, and Field work), (ii) Part – II (Elective subjects – Inter disciplinary or Extra disciplinary subjects), (iii) Part – III: a set of papers recommended by UGC and TANSCHE (Soft skills), (iv) Part – IV: Internship, and (v) Part – V: Certificate course.

The detail of the Study for Master Degree Courses shall consist of the following:

PART – I Core Subjects – Theory, Practicals, Project / Field workPG students shall be required to take up Project / Field Work and submit the Project Report during the second year. The Head of the Department shall allot the Guide who in turn will suggest the Project Work to the students. Two typed copies of the Project Report shall be submitted to the Department before the due date and one copy will be forwarded to the Controller of Examinations. For the Project Report, the maximum internal marks will be 20 percent the maximum external marks will be 60 per cent and for the Viva-Voce 20 per cent(If in some programmes, if the project is equivalent to more than one paper, the project marks would be in proportion to the number of equivalent papers). Each student shall be required to appear for Viva-Voce Examination in defence of the Project only.

PART – II Elective Subjects – Inter-disciplinary or Extra-disciplinary or self study elective oropen elective

PART – III Skill Based Subjects - Soft Skills

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed papers on Soft Skills. For three years PG degree Programme, a candidate must undergo a minimum of 2 papers (2 x 2 = 4 credits). Papers will be finalized in due course.

PART – IV Internship

Each PG student shall appear for internship training during the vacation of II Semester for a minimum period of 15 days and shall submit the report to the controller of examinations. Each student is allotted 4 credits on submission of the report.

PART – V Certificate Courses

A candidate shall be awarded with two credits for each certificate course. A candidate shall be eligible for the award of the degree only if he/she has undergone one certificate course. For two years PG degree Programme, a candidate must undergo one certificate course (2 credits). Titles of the courses will be finalized in due course.

The concerned Board of Studies will choose the convenient credit pattern for every paper based on the requirement. However, generally, a paper shall be of 2 - 6 credits.

Different courses of study are labeled and defined as follows:

Core Course

A course which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main discipline / subject of study or from a sister/related discipline / subject which supports the main discipline / subject. In contrast to the phrase Soft Core, a compulsory core course is called a **Hard Core** Course**.**

Elective Course

Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline / subject of study or which provides an extended scope or which enables an exposure to some other discipline / subject / domain or nurtures the candidate's proficiency/ skill is called an Elective Course. Elective courses may be offered by the main discipline / subject of study or by sister / related discipline / subject of study. A Soft Core course may also be considered as an elective.

An elective course chosen generally from an unrelated discipline / subject, with an intention to seek exposure is called an **open elective**. An elective course designed to acquire a special / advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher is called a

Self-Study Elective.

A core course offered in a discipline / subject may be treated as an elective by other discipline / subject and vice versa.

Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing / exploring a real life situation / difficult problem. A project work up to 4 - 6 credits is called Minor Project work. A project work of 8 - 12 credits is called Major Project Work. Dissertation work can be of 8 - 12 credits. A Project / Dissertation work may be a hard core or a soft core as decided by the Board of Studies concerned.

Student Advisor

All teachers of the department shall function as student advisors. There will be more or less an equal number of students assigned to each student advisor of a department. The student advisor will help the students in choosing core and elective courses of study. The student advisor shall be responsible for registration of courses (subjects) by his students. The student advisor will offer all possible student support services.

8. CREDITS

The term credit is used to describe the quantum of syllabus for various programmes in terms of periods of study. It indicates differential weightage given according to the contents duration of the courses in the curriculum design. The minimum credit requirement for a two year Master's programme shall be **90** credits. Each subject (course) is designed variously under lectures / tutorials / laboratory work / seminar / project work etc., to meet effective teaching and learning needs and credits are assigned suitably.

One credit for each lecture / tutorial / project work period per week shall be alloted. In practical, each credit should cover minimum of six experiments. One credit is alloted for two practical hours. Thus normally, in each of the subject, credits will be assigned on the basis of the lectures / tutorials / laboratory work / project work and other forms of learning in a 15 week schedule.

9. SCHEME OF EXAMINATION

There shall be continuous, comprehensive evaluation of students through internal and external examination. At least 2 internal examinations (Sessional Tests) per semester and 1 semester ending examination should be conducted.

Sessional Test I will he held during sixth week for syllabi covered till then. Sessional Test Iwill be a combination of a variety of tools such as class test, assignment, papr presentation etc., that would be suitable for the paper. This required an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However the tests are compulsory. Test I may be for one hour duration. The pattern of question paper will be decided by the respective board of studies.

Sessional Test I will carry 20% of marks of the entire paper.

Sessional Test II will he held during eleventh week for syllabi covered between seventh andeleventh weeks. Sessional Test I will be a combination of a variety of tools such as class test, assignment, paper presentation etc., that would be suitable for the paper. It will also have an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However the tests are compulsory. Test II may be for one hour duration. The pattern of question paper will be decided by the respective board of studies.

Sessional Test II will carry 20% of marks of the entire paper.

There will be one End Semester examination of 2 - 3 hours duration in each paper. The End semester examination will cover all the syllabi of the paper for 60% of Marks.

A dissertation may be offered in lieu of one / two papers / practicals. It shall be evaluated by two examiners one external and one internal appointed by the Controller of Examination.

Wherever there is viva-voce, it shall be conducted by the common Viva Board consisting of the Chairman and internal members of the Board of Examination in the concerned subject, internal guide and one external expert as approved by the Controller of Examinations.

End semester practical examinations shall be held before the theory examinations to benefit the students to undertake examinations of other departments.

APPENDIX- (R)

M.SC. DEGREE COURSE IN MATHEMATICS

Scheme of Examinations:

SEMESTER-I

Paper number	Course components/title	Credits	Exam hours	Marks		Total
				CIA	UE	
Core Paper - I	Algebra-I	4	3	25	75	100
Coe Paper - II	Real Analysis-I	4	3	25	75	100
Coe Paper - III	Ordinary Differential Equations	4	3	25	75	100
Core Paper- IV	Graph Theory	4	3	25	75	100
Elective Paper – I	(Choose one from Group-A)	4	3	25	75	100
Soft Skill Paper–I		2	3	40	60	100

Elective - I

Any one of the following courses from Group-A shall be chosen as an Elective-I.

Group-A:

1. Formal Languages and Automata Theory
2. Discrete Mathematics
3. Mathematical Economics
4. Fuzzy sets and Applications.

SEMESTER-II

Paper Number	Course Components/Title	Credits	Exam Hours	Marks		Total
				CIA	UE	
Core Paper - V	Algebra-II	4	3	25	75	100
Core Paper - VI	Real Analysis- II	4	3	25	75	100
Core Paper - VII	Partial Differential Equations	4	3	25	75	100
Core Paper- VIII	Probability Theory	4	3	25	75	100
Elective Paper - II	(Choose one from Group B)	4	3	25	75	100
Soft Skill Paper –II		2	3	40	60	100
	*Summer Internship	2				

Elective-II

Any one of the following courses from Group-B shall be chosen as an Elective-II.

Group-B:

5. Programming in C ++ and Numerical Methods
6. Mathematical Programming
7. Wavelets
8. Java Programming

THIRD SEMESTER

Paper Number	Course Components/Title	Credits	Exam Hours	Marks		Total
				CIA	UE	
Core Paper – IX	Complex Analysis-I	4	3	25	75	100
Core Paper – X	Topology	4	3	25	75	100
Core Paper - X1	Operations Research	4	3	25	75	100
Core Paper - XII	Mechanics	4	3	25	75	100
Elective Paper -III	(Choose one from Group C)	4	3	25	75	100
Soft Skill Paper -III		2	3	40	60	100

Elective-III

Any one of the following courses from Group-C shall be chosen as Elective-III

Group-C

9. Algebraic Theory of Numbers
10. Number Theory and Cryptography
11. Stochastic Processes
12. Data Structures and Algorithms

FOURTH SEMESTER

Paper Number	Course Components/Title	Credits	Exam Hours	Marks		Total
				CIA	UE	
Core Paper - XIII	Complex Analysis-II	4	3	25	75	100
Core Paper - XIV	Differential Geometry	4	3	25	75	100
Core Paper - XV	Functional Analysis	4	3	25	75	100
Elective Paper - IV	(Choose one from Group D)	4	3	25	75	100
Elective Paper - V	(Choose one from Group E)	4	3	25	75	100
Soft Skill Paper -IV		2	3	40	60	100

Elective-IV

Any one of the following papers from Group-D shall be chosen as Elective-IV.

Group-D:

13. Fluid Dynamics
14. Combinatorics
15. Mathematical Statistics
16. Algebraic Topology

Elective-V

Any one of the following papers from Group-E shall be chosen as Elective-V

Group – E

17. Tensor Analysis and Relativity
18. Mathematical Physics
19. Financial Mathematics
20. Calculus of Variations and Integral Equations.

AC.S'15.

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Question Paper Pattern for External Examination

SECTION – A (50words)

10 out of 12 - 10 X 1 marks = 10 marks

SECTION – B (200words)

4 out of 6 - 5 x 5 marks = 25 marks

SECTION – C (500words)

3 out of 5 - 4 x 10marks = 40 marks

TOTAL = 75 marks

The offer of an Add-on Courses to the students in various disciplines is to enhance their employability. The number of working hours per week for the students for getting the **90** prescribed credits should not exceed 30 hours of class per week and no faculty member should be allocated extra hours beyond the prescribed 16 lecture hours.

Marks for continuous internal assessment (CIA) shall be awarded on the basis of tests, seminars, field work, assignment etc as determined by the Board of Studies in the respective subject. The internal assessment marks shall be notified on the department notice board for information of the students and it shall be communicated to the Controller of Examinations 5 days before the commencement of the **End Semester examinations**, and the Controller of Examinations shall have access to the records of such internal assessment evaluations.

The following procedure be followed for Internal Marks

Theory

Papers: **Internal Marks 25**

Theory based Continuous Internal Assessment (CIA) – 20

Tests (2 out of 3)	= 10
Attendance*	= 5
Seminars	= 5
Assignments	= 5

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25 marks

***Break-up Details for Attendance**

Below 60%	- No marks
60% to 75%	- 3marks
76% to 90 %	- 4marks
91% to 100%	- 5marks

Practice based Continuous Internal Assessment (CIA) – 20 provided based upon the type of the practice recommended by board of studies to the respective paper for example: quiz, report generation, problem solving, etc.,

Practical:	**Internal Marks40**
Attendance	5 marks
Practical Test best 2 out of 3	30 marks
Record	5 marks
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	40 marks

A model practical examination is conducted for awarding CIA marks for practical. Question paper pattern for CIA examination is similar to the pattern of end semester examination as decided by Board of Studies.

Project:	**InternalMarks 20**	
Internal Marks	Best 2 out of 3 presentations	20 marks
Viva		20 marks
Project Report		60 mark

Field work:

Each student is required to take up a field work in an industry for a period of 36 days and submit a report. The students would begin the field work activities in the beginning of the VI Semester and submit the report for evaluation by the Institute/college. The report shall not exceed 75 typed pages excluding tables, figures, bibliography and appendices. The report shall be valued by the Institute/College by constituting a committee headed by the Professor and Head of Faculty/Department known as VIVA VOCE Exam Committee. The marks shall be distributed as follows:

Internal : 20 marks (by the faculty/department guide)
External (Viva and Report) : 80 marks (marks by the VIVA VOCE Exam Committee)
Total : 100 marks
Necessary guidance will be given to the students for the completion of field work. Wherever the Committees are formed for external evaluation, an external examiner shall be appointed with the approval of the Head of the Institute/Colleges.
In order to motivate students to be free of rot learning, various mechanism of internal evaluation should be adopted such as group discussion, paper reading, home assignments and viva voce.

10. INSTANT EXAMINATION

Candidates who have passed all the theory papers upto 3rd semester and failed in only one paper pertaining to the 4th semester can apply for Instant Examination. Application form with a demand draft for Rs.400/-, drawn in favour of "The Principal, Sri Sankara Arts and Science College, Enathur" should be submitted on or before 10 days after the publication of results. The

results are published within 15 days after the date of examinations.

Details on the number of courses and credits per course in different PG programmes

No.	Components	M.Sc			
		Number of Courses	Credits Per course	Total Credits	Total Weekly hours / 120 weekly hours (4 sem X 30hrs)
1.	Part I – Hard core	6	4	24	36
2.	Part I – Hard core	4	3	12	24
3.	Part I – Hard core	1	12	12	12
4.	Part I – Soft core	4	4	16	20
5.	Part II – Optional	4	4	16	24
6.	Part III – Soft skill	2	2	4	4
7.	Part IV: Internship	1	4	4	
8.	Part V: Certificate	1	2	2	
	Total			**90**	**120**

11. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

1. Candidates shall register their names for the First Semester Examination after the admission in PG Courses.
2. Candidates shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subject of earlier semesters along the current (subsequent) Semester Subjects.

iii. Candidates shall be eligible to go to subsequent semester, only if they earn sufficient attendance as prescribed there for by the Academic Council from time to time.

Provided in case of a candidate earning less than 50% of attendance in any one of the Semesters due to any extraordinary circumstances such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorised 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 missed Semester by rejoining after completion of Final Semester of the course, after paying the fee for the break of study as prescribed by the Academic Council from time to time.

iv. There shall be examinations at the end of each semester, for odd semesters in the month of October / November, for even semesters in April / May. A candidate who does not pass the examination in any paper(s) shall be permitted to appear in such failed papers in the subsequent examinations to be held in October / November or April / May.

v. The results of all the examinations will be published through the college Website.

12. PASSING MINIMUM

A candidate shall be declared to have passed:

* There shall be no Passing Minimum for Internal.

* For External Examination, Passing Minimum shall be of 50 % (Fifty Percentage) of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-voce.

* In the aggregate (External + Internal) the passing minimum shall be of 50%.

* He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practicals wherever prescribed / as per the scheme of examinations by earning **90**

CREDITS in Parts-I, II, III, IV & V. He / She shall also complete one certificate course to qualify for the Degree.

A candidate who fails in any of the unit / project work / Project Report / dissertation / viva-voice shall reappear in that unit / project work / Project Report / Dissertation / viva-voice and pass the examination subsequently.

13. CLASSIFICATION OF SUCCESSFUL CANDIDATES

PART- I CORE SUBJECTS (COURSE): Successful candidates passing the Examinations for the Language and securing the marks 60 percent and above in the aggregate shall be declared to have passed the examination in the FIRST Class. All other successful candidates shall be declared to have passed the examination in the SECOND Class.

PART – II ELECTIVE SUBJECTS (COURSE): Successful candidates passing the examinations for English and securing the marks 60 percent and above in the aggregate shall be declared to have passed the examination in the FIRST Class. All other successful candidates shall be declared to have passed the examination in the SECOND class.

PART – III Soft skill

Successful Candidate earning of 2 credits for soft skill paper SHALL NOT BE taken into consideration for Classification / Ranking / Distinction.

PART – IV INTERNSHIP

Successful Candidate earning of 2 credits for internship SHALL NOT BE taken into consideration for Classification / Ranking / Distinction.

PART – V CERTIFICATE COURSE

Successful Candidate earning of 2 credits for certificate course SHALL NOT BE taken into consideration for Classification / Ranking / Distinction.

14. RANKING

Candidates who pass all the examinations prescribed for the Course in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking / Distinction.

Provided in the case of Candidates who pass all the examinations prescribed for the Course with a break in the First Appearance due to the reasons as furnished in the Regulations 11(iii) category are only eligible for Classification.

15. APPEARANCE FOR IMPROVEMENT

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his/her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his/her first semester of his/her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration**.** No candidate will be allowed to improve marks in the Practical, Project, Viva-voce, and Field work.

16. CONDONATION

Students must have 75% of attendance in each course for appearing the examination. Students who have 74% to 70% of attendance shall apply for condonation in the prescribed form with the prescribed fee Rs.250/-. Students who have 69% to 60% of attendance shall apply for

condonation in prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester(s) after completion of the programme.

17. RETOTALING

Candidates are permitted to apply for re-totaling within 10 days from the date of publication of results. The student should submit request for re-totaling in the prescribed format and pay a fee of Rs.125/- per paper.

18. PHOTOCOPY OF ANSWER SCRIPT

Candidates are permitted to apply for obtaining a photocopy of answer paper within 20 days from the date of publication of results. The student should submit request for photocopy of answer script in the prescribed format and pay a fee of Rs. 400/- per paper.

19. REVALUATION

Candidates are permitted to apply for revaluation after obtaining a photocopy of answer paper within 30 days from the date of publication of results. The student should submit request for revaluation in the prescribed format and pay a fee of Rs. 600/- per paper.

20. MALPRACTICE

Any malpractice by the students debars them from subsequent appearance based on the decision of the examination committee. In all cases of malpractice their conduct certificates will indicate malpractice.

21. EVALUATION AND GRADING SYSTEM

The performance of a student in each paper is evaluated in terms of percentage of marks with a provision for conversion to grade points (GP). Evaluation for each paper shall be done by a continuous internal assessment by the concerned paper teacher as well as by an end semester examination and will be consolidated at the end of the course.

The term grading system indicates a Ten Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.

Once the marks of the Internal and end-semester examinations for each of the papers are available, they will be added. The marks thus obtained will then be graded as per details provided in Table.

The sum of total performance in each semester will be rated by **Grade Point Average (GPA)** while the continuous performance from the second semester onwards will be marked by **Cumulative Grade Point Average (CGPA).**These two are calculated by the followingformulae.

$$GPA = \frac{\text{Sum of [Credits acquired x Grade points]}}{\text{Sum of Credits acquired}}$$

For the calculation of Grade Point Average (GPA), G_i is the grade point awarded; C_i is the credit units earned for the i^{th} paper.

$$CGPA = \frac{\sum_{i=1}^{n} C_i GP_i}{\sum_{i=1}^{n} C_i}$$

Where 'C_i' is the Credit earned for the paper i in any semester; 'G_i' is the Grade Point obtained by the student for the paper i and 'n' is the number of papers **passed** in that or **CGPA** = GPA of all the papers starting from the first semester to the current semester.

Note: The GPA and CGPA shall be calculated separately for the following five parts:

22. Part I: Core Subject; Part II: Elective Subject, Part III: Skill based subjects, Part IV: Internship and Part V: Certificate course

Marks	Grade Point	CGPA	Letter Point	Classification of Final Result
96 and above	10	9.51 and above	**S$^+$**	First Class with Exemplary
91 – 95	9.5	9.01 – 9.50	**S**	
86 – 90	9.0	8.51 – 9.00	**$_D$++**	First Class with Distinction
81 – 85	8.5	8.01 – 8.50	**D$^+$**	
76 – 80	8.0	7.51 – 8.00	**D**	
71 – 75	7.5	7.01 – 7.50	**$_A$++**	First Class
66 – 70	7.0	6.51 – 7.00	**A$^+$**	
61 – 65	6.5	6.01 – 6.50	**A**	
56 – 60	6.0	5.51 – 6.00	**B$^+$**	Second Class
51 – 55	5.5	5.01 – 5.50	**B**	
46 – 50	5.0	4.51 – 5.00	**C$^+$**	Third Class
40 – 45	4.5	4.00 – 4.50	**C**	
Below 40	0	Below 4.00	**F**	Fail

The grade card / mark sheet issued at the end of the semester to each student will contain the following:

a. the marks obtained for each paper registered in the semester
b. the credits earned for each paper registered for that semester
c. the performance in each paper by the letter grade point obtained
d. the Grade Point Average (GPA) of all the papers registered for that semester and
e. from the second semester onwards, the Cumulative Grade Point Average (CGPA) of all the papers and
f. the class and grade of the student in the final CGPA

23. TRANSITORY PROVISION

Candidates who have undergone the course of study prior to the academic year 2015-2016 will be permitted to appear for the examinations under those Regulations for a period of TWO years i.e. upto and inclusive of April - May 2017 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

24. ADD ON COURSES (AOC) – Certificate Courses

Eligibility for Admissions: All students enrolled for the PG courses are eligible and requiredto pursue the AOC offered in the semester they are offered by the department.

Registering for the Add on course: The AOC shall be taken in the same semester, when it isoffered. There is no provision for the students to opt for the AOC in any other time.

Duration of the Courses: The Add on courses extends to the duration of each semester

theyare offered. Total of 40 hours are utilized for teaching each certificate course.

Hours of Instruction per week: There shall be 2 hours of input for theory papers and 4 hoursfor practical papers. These hours may be distributed for lectures, seminars, tutorials, project work, presentations and other modes of instruction which individual add on courses may demand. The hours of instructions should not overlap the regular hours of teaching in the semester.

Period for Completion of the Add on Courses: The candidates shall complete the AOC in thesemester they are offered. They will be graded as C – Completed or NC – Not Completed. Those who do not satisfactorily complete the course will be declared as "Not Complete". Candidates who have not satisfactorily completed the course will be provided another opportunity to complete the course as it is a Credit Course and two credits are provided for the completed students.

Attendance: Each "add-on-course" shall be treated as an independent unit for the purposeof attendance. A student shall attend a minimum of 75% of the total instruction hours in the paper including tutorials and seminars. There is no provision for condonation of shortage of attendance and those students failing to get the minimum attendance will be declared as "Not Completed" the course.

Course Credit Assignment for Add on courses: All add-on courses are credit based courses. Two credits provided to each add-on course. The course will be designed by the instructor who will have to conduct the course and assess the students.

Scheme of Examination: There will be continuous evaluation of the "add on course" which will include a term end examination, and continuous evaluation based on seminars, field work, assignment and other appropriate assessment tools.

SYLLABUS

(With effect from the academic year 2015-2016)

M.SC. DEGREE COURSE IN MATHEMATICS

SCHEME OF EXAMINATIONS:

SEMESTER-I

PAPER NUMBER	COURSE COMPONENTS/TITLE	Credits	Exam Hours	Marks		Total
				CIA	UE	
Core Paper - I	Algebra-I	4	3	25	75	100
Core Paper - II	Real Analysis-I	4	3	25	75	100
Core Paper - III	Ordinary Differential Equations	4	3	25	75	100
Core Paper- IV	Graph Theory	4	3	25	75	100
Elective Paper - I	Discrete Mathematics	4	3	25	75	100
Soft Skill Paper–I		2	3	40	60	100

SEMESTER-II

Core Paper - V	Algebra-II	4	3	25	75	100
Core Paper - VI	Real Analysis- II	4	3	25	75	100
Core Paper - VII	Partial Differential Equations	4	3	25	75	100
Core Paper- VIII	Probability Theory	4	3	25	75	100
Elective Paper - II	Java Programming	4	3	25	75	100
Soft Skill Paper -II		2	3	40	60	100
	*Summer Internship	2				

THIRD SEMESTER

PAPER NUMBER	COURSE COMPONENTS/TITLE	Credits	Exam Hours	Marks		Total
				CIA	UE	
Core Paper - IX	Complex Analysis-I	4	3	25	75	100
Core Paper - X	Topology	4	3	25	75	100
Core Paper - X1	Operations Research	4	3	25	75	100
Core Paper - XII	Mechanics	4	3	25	75	100
Elective Paper -III	Stochastic Processes	4	3	25	75	100
Soft Skill Paper -III		2	3	40	60	100

FOURTH SEMESTER

Core Paper - XIII	Complex Analysis-II	4	3	25	75	100
Core Paper - XIV	Differential Geometry	4	3	25	75	100
Core Paper - XV	Functional Analysis	4	3	25	75	100
Elective Paper – IV	Fluid Dynamics	4	3	25	75	100
Elective Paper – V	Calculus of Variations and Integral Equations	4	3	25	75	100
Soft Skill Paper –IV		2	3	40	60	100

M.Sc. DEGREE COURSE IN MATHEMATICS

REVISED SYLLABUS
Semester -I
Core Paper I- Algebra – I

UNIT I: Group actions on a set, Sylow theorems - Applications of Sylow theorems.
Chapter 3: Section 3.6
Chapter 4 – Sections 4.2 and 4.3
from I.N. Herstein

UNIT II: Direct products - Finite abelian groups- Modules
Chapter 2: Sections 2.13 and 2.14
Chapter 4: Section 4.5
from I.N. Herstein

UNIT III: Linear Transformations - Canonical forms -Triangular for– Nilpotent transformations.
Chapter 6: Sections 6.4 , 6.5
from I.N. Herstein

UNIT IV: Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7
from I.N. Herstein

UNIT V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)
from I.N. Herstein

Recommended Text :

1. I.N. Herstein. Topics in Algebra (II Edition) Wiley, 2002.

CORE PAPER-II-REAL ANALYSIS –I

UNIT-I : Functions of bounded variation

Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Chapter – 6 : Sections 6.1 to 6.8

Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series.

Chapter 8 : Sections 8.8, 8.15, 8.17

UNIT-II : The Riemann - Stieltjes Integral

Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems.

Chapter - 7 : Sections 7.1 to 7.14

UNIT-III : The Riemann-Stieltjes Integral

Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals - The integrals as a function of the interval - Second fundamental theorem of integral calculus-Change of variable in a Riemann integral-Second Mean Value Theorem for Riemann integral.

Chapter - 7 : 7.15 to 7.22

UNIT-IV: Infinite Series and infinite Products

Double sequences - Double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesarosummability - Infinite products.

Chapter - 8 Sec, 8.20, 8.21, 8.23 TO 8.26

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

Chapter 9 : Sections 9.15, 9.19, 9.20, 9.22, 9.23

UNIT-V: Sequences of Functions

Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Uniform convergence and Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Chapter -9 Sec 9.1 to 9.6, 9.8,9.9, 9.10,9.11, 9.13

Recommended Text

Tom M.Apostol :Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Core Paper III - Ordinary Differential Equations

UNIT-I : Linear equations with constant coefficients Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Chapter 2: Sections 1 to 6

UNIT-II : Linear equations with constant coefficients Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation.

Chapter 2 : Sections 7 to 11.

UNIT-III : Linear equation with variable coefficients Initial value problems -Existence and uniqueness theorems – Solutions to solve a non- homogeneous equation – Wronskian and linear dependence – Reduction of the order of a homogeneous equation – Homogeneous equation with analytic coefficients-The Legendre equation.

Chapter : 3 Sections 1 to 8 (omit section 9)

UNIT-IV : Linear equation with regular singular points Second order equations with regular singular points –Exceptional cases – Bessel equation .

Chapter 4 : Sections 3, 4 and 6 to 8 (omit sections 5 and 9)

UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – Method of successive approximations – the Lipschitz condition – Convergence of the successive approximations and the existence theorem.

Chapter 5 : Sections 1 to 6 (omit Sections 7 to 9)

Recommended Text

1.E.A.Coddington, An introduction to ordinary differential equations (3^{rd} Printing) Prentice-Hall of India Ltd.,New Delhi, 1987.

CORE PAPER IV- GRAPH THEORY

UNIT-I : Graphs, subgraphs and Trees

Graphs and simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles – Trees – Cut Edges ana Bonds – Cut Vertices.

Chapter 1 (Section 1.1 – 1.7)
Chapter 2 (Section 2.1 – 2.3)

UNIT-II: Connectivity, Euler tours and Hamilton Cycles

Connectivity – Blocks – Euler tours – Hamilton Cycles.

Chapter 3 (Section 3.1 – 3.2)
Chapter 4 (Section 4.1 – 4.2)

UNIT-III :Matchings, Edge Colourings

Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.

Chapter 5 (Section 5.1 – 5.2)
Chapter 6 (Section 6.1 – 6.2)

UNIT-IV : Independent sets and Cliques, Vertex Colourings

Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.

Chapter 7 (Section 7.1 – 7.2)
Chapter 8 (Section 8.1 – 8.2, 8.4)

UNIT-V:Planar graphs

Plane and planar Graphs – Dual graphs – Euler's Formula – The Five- Colour Theorem and the Four-Colour Conjecture.

Chapter 9 (Section 9.1 – 9.3, 9.6)

Recommended Text

1.J.A.Bondy and U.S.R. Murthy ,Graph Theory and Applications , Macmillan, London, 1976.

ELECTIVE PAPER-I -DISCRETE MATHEMATICS

UNIT-I : Lattices

Properties of Lattices: Lattice definitions – Modular and distributive lattice; Boolean algebras: Basic properties – Boolean polynomials, Ideals; Minimal forms of Boolean polynomials.

Chapter 1: § 1 A and B § 2A and B. § 3.

UNIT-II : Applications of Lattices

Switching Circuits: Basic Definitions - Applications

Chapter 2: § 1 A and B

UNIT-III :Finite Fields

Chapter 3: § 2

UNIT-IV :Polynomials

Irreducible Polynomials over Finite fields – Factorization of Polynomials

Chapter 3: § 3 and §4.

UNIT-V: Coding Theory

Linear Codes and Cyclic Codes

Chapter 4 § 1 and 2

Recommended Text

1.Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, Spinger-Verlag, New York, 1984.

Semester - II
Core Paper V - Algebra – II

UNIT I - Extension fields - Transcendence of e.
Chapter 5: Section 5.1 and 5.2

UNIT II - Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5

UNIT III - Elements of Galois theory.
Chapter 5 : Section 5.6

UNIT IV - Finite fields - Wedderburn's theorem on finite division rings
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

UNIT V - Solvability by radicals–Galois groups over the rationals -–A theorem ofFrobenius.

Chapter 5: Sections 5.7 and 5.8
Chapter 7: Sections 7.3

Recommended Text :

I.N. Herstein. Topics in Algebra (II Edition) Wiley 2002

CORE PAPER-VI -REAL ANALYSIS – II

UNIT-I : Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)

UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)

UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)

UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1
Chapter 12 : Section 12.1 to 12.14 (Apostol)

UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.
Chapter 13 : Sections 13.1 to 13.7 (Apostol)

Recommended Text

1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)

2. Tom M.Apostol :Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

CORE PAPER-VII- PARTIAL DIFFERENTIAL EQUATIONS

UNIT-I : Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution
Chapter 2 : Sections 2.1 to 2.6
Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)

UNIT-II : Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.
Chapter 4 : Sections 4.1 to 4.11

UNIT-III : Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem.- Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations
Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)

UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.
Chapter 8 : Sections 8.1 to 8.9

UNIT-V : Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.
Chapter 10 : Section 10.1 to 10.9

Recommended Text

1.TynMyint-U and LokenathDebnath, Partial Differential Equations for Scientists and Engineers (Third Edition), North Hollan, New York, 1987.

CORE PAPER-VIII-PROBABILITY THEORY

UNIT-I : **Random Events and Random Variables:** Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7
Chapter 2: Sections 2.1 to 2.9

UNIT-II: Parameters of the Distribution : Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3: Sections 3.1 to 3.8

UNIT-III:Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4: Sections 4.1 to 4.7

UNIT-IV :Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5: Section 5.1 to 5.10 (Omit Section 5.11)

UNIT-V:Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – LapunovTheroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)

Recommended Text

1. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

ELECTIVE PAPER-II-JAVA PROGRAMMING
(Theory 80 marks + Computer Laboratory 20 marks)

SEMESTER II

UNIT-I : Java Tokens – Java statements – Constants – Variables – Data types

Chapters 3 and 4

UNIT-II : Operators – Expressions – Decision making and Branching.

Chapters 5,6 and 7

UNIT-III : Classes – Objects – Methods – Arrays – Strings – Vectors – Multiple Inheritance

Chapters 8, 9 and 10

UNIT-IV : Multithreaded Programming – Managing errors and Exceptions

Chapters 12 and 13

UNIT-V : Applet Programming

Chapter 14

Recommended Text

E. Balagurusamy, Programming with Java – A primer , Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Semester III

Core Paper IX - Complex Analysis – I

UNIT I: Cauchy's Integral Formula: The Index of a point with respectto a closed curve - The Integral formula - Higher derivatives.

Local Properties of Analytical Functions : Removable Singularities-Taylors's Theorem-Zeros and poles-The local Mapping - The Maximum Principle .

Chapter 4 : Section 2 : 2.1 to 2.3, Section 3 : 3.1 to 3.4

UNIT II:The general form of Cauchy's Theorem : Chains and cycles-SimpleConnnectivity -Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem – Locally exact differentials-Multilply connected regions – Residue theorem - The argument principle.

Chapter 4 : Section 4 : 4.1 to 4.7, Section 5: 5.1 and 5.2

UNIT III - Evaluation of Definite Integrals and Harmonic Functions:

Evaluation of definite integrals - Definition of Harmonic functions and basic properties - Mean value property - Poisson formula.

Chapter 4 : Section 5 : 5.3, Section 6 : 6.1 to 6.3

UNIT IV - Harmonic Functions and Power Series Expansions:

Schwarz theorem - The reflection principle - Weierstrass theorem - Taylor Series - Laurent series .

Chapter 4 : Sections 6.4 and 6.5

Chapter 5 : Sections 1.1 to 1.3

UNIT V - Partial Fractions and Entire Functions: Partial fractions– Infinite products - Canonical products - Gamma Function - Jensen's formula

Chapter 5 : Sections 2.1 to 2.4, Section 3.1

Recommended Text :

Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979

CORE PAPER X – TOPOLOGY

UNIT-I :Metric Spaces: Convergence, completeness and Baire's Theorem; Continuous mappings;Spaces of continuous functions; Euclidean and Unitary spaces. **Topological Spaces: D**efinition and Examples; Elementary concepts.
Chapter Two (Sec 12 - 15) Chapter Three (Sec 16 & 17)

UNIT-II :Topological Spaces (contd…) Open bases and subbases; Weak topologies; the function algebras C(X,R) and C(X,C): **Compact spaces.**
Chapter Three (Sec 18 - 20) Chapter Four (Sec 21)

UNIT-III : Tychonoff's theorem and locally compact spaces; Compactness for metric spaces; Ascoli's theorem.
Chapter Four (Sec 23 - 25)

UNIT-IV :T_1 – spaces and Hausdorff spaces; Completely regular spaces and normal spaces; Urysohn's lemma and the Tietze extension theorem; The Urysohn imbedding theorem.
Chapter Five (Sec 26 - 29)

UNIT-V: The Stone – Cechcompactification; Connected spaces; The components of a space; Totally disconnected spaces; Locally connected spaces; The Weierstrass approximation Theorem.
Chapter Five (Sec 30) Chapter Six (Sec 31 - 34)
Chapter Seven (Sec 35)

Recommended text book:

1.GeorgeF.Simmons, Introduction to Topology and Modern Analysis, Tata-McGraw Hill. New Delhi, 2004

Core Paper-XI-Operations Research

UNIT-I: Decision Theory : Steps in Decision theory Approach – Types of Decision-Making Environments – Decision Making Under Uncertainty – Decision Making under Risk – Posterior Probabilities and Bayesian Analysis – Decision Tree Analysis – Decision Making with Utilities.

Chapter 10: Sec. 10.1 to 10.8

UNIT-II: Project Management : PERT and CPM : Basic Differences between PERT and CPM – Steps in PERT/CPM Techniques – PERT/CPM Network Components and Precedence Relationships – Critical Path Analysis – Probability in PERT Analysis – Project time-cost Trade Off – Updating the Project – Resource Allocation

Chapter 12: Sec. 12.1 to 12.9

UNIT-III: Deterministic Inventory Control Models: Meaning of Inventory Control – Functional Classification – Advantage of Carrying Inventory – Features of Inventory System – Inventory Model building - Deterministic Inventory Models with no shortage – Deterministic Inventory with Shortages

Probabilistic Inventory Control Models:

Single Period Probabilistic Models without Setup cost – Single Period Probabilities Model with Setup cost.

Chapter 13: Sec. 13.1 to 13.8

Chapter 14: Sec. 14.1 to 14.3

UNIT-IV: Queues Theory : Essential Features of Queueing System – Operating Characteristic of Queueing System – Probabilistic Distribution in Queueing Systems – Classification of Queueing Models – Solution of Queueing Models – Probability Distribution of Arrivals and Departures – Erlangian Service times Distribution with k-Phases.

Chapter 15 : Sec. 15.1 to 15.8

UNIT-V: Replacement and Maintenance Models: Failure Mechanism of items – Replacement of Items Deteriorates with Time – Replacement of items that fail completely – other Replacement Problems.

Chapter 16: Sec. 16.1 to 16.5

Recommended Text

1. J.K.Sharma, Operations Research ,MacMillan India, New Delhi, 2001.

Core Paper-XII-MECHANICS

UNIT-I : Mechanical Systems : **The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum**
Chapter 1 : Sections 1.1 to 1.5

UNIT-II : Lagrange's Equations: **Derivation of Lagrange's equations- Examples- Integrals of motion.**
Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)

UNIT-III : Hamilton's Equations : **Hamilton's Principle - Hamilton's Equation - Other variational principle.**
Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)

UNIT – IV : Hamilton-Jacobi Theory : **Hamilton Principle function – Hamilton-Jacobi Equation - Separability**
Chapter 5 : Sections 5.1 to 5.3

UNIT-V : Canonical Transformation : **Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.**
Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6)

Recommended Text

1. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Elective Paper-III- STOCHASTIC PROCESSES

UNIT-I : Markov Chains : Classification of General Stochastic Processes – Markov Chain – Examples – Transition Probability Matrix – Classifications of States – Recurrence – Examples of recurrent Markov Chains.

Chapter 1: Section 3 only
Chapter 2: Sections 1 to 6 (Omit section 7)

UNIT-II: Limit Theorems of Markov Chains: Discrete renewal equation and its proof – Absorption probabilities – criteria for recurrence – Queuing models – Random walk.

Chapter 3: Sections 1 to 7
UNIT-III: Continuous Time Markov Chains: Poisson Process – Pure Birth Process – Birth and Death Process – Birth and Death process with absorbing states – Finite State Continuous time Markov Chains.

Chapter 1: Section 2 (Poisson Process)

Chapter 4: Sections 1,2 and 4 to 7 (Omit sections 3 and 8)

UNIT-IV: Renewal Processes: Definition and related concepts – Some special Renewal processes – Renewal equation and Elementary Renewal Theorem and its applications.
Chapter 5: Sections 1 to 6.

UNIT-V: Brownian Motion : Definition – Joint probabilities for Brownian Motion – Continuity of paths and the maximum variables – Variations and extensions – Computing some functionals of Brownian Motion by Martingale methods.
Chapter 1: Section 2 (Brownian Motion)

Chapter 6: Sections 1 to 5 and 7A only (Omit Sections 6, and 7B,C)

Recommended Text

1. S.Karlin and H.M.Taylor.A First Course in Stochastic Processes(2^{nd} edition), Academic Press, New York, 1975.

Semester -IV

COMPLEX ANALYSIS- II

UNIT-I : Riemann Theta Function and Normal Famalies : Product development – Extension of $\zeta(s)$ to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classcial Definition
Chapter 5 : Sections 4.1 to 4.4
Chapter 5 : Sections 5.1 to 5.5

UNIT-II : Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle. Conformal mappings of polygons :Behaviour at an angle Schwarz-Christoffel formula – Mapping on a rectangle. Harmonic Functions : Functions with mean value property – Harnack's principle.
Chapter 6 : Sections 1.1 to 1.3 (Omit Section1.4)
Chapter 6 : Sections 2.1 to 2.3 (Omit section 2.4)
Chapter 6 : Section 3.1 and 3.2

UNIT-III : Elliptic functions : Simply periodic functions – Doubly periodic functions
Chapter 7 : Sections 1.1 to 1.3
Chapter 7 : Sections 2.1 to 2.4

UNIT-IV : Weierstrass Theory : The Weierstrass $\wp$-function – The functions $\zeta(s)$ and $\sigma(s)$ – The differential equation – The modular equation $\lambda(\tau)$ – The Conformal mapping by $\lambda(\tau)$.
Chapter 7 : Sections 3.1 to 3.5

UNIT-V: Analytic Continuation :The Weiertrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.
Chapter 8 : Sections 1.1 to 1.7

Recommended Text

1. Lars F. Ahlfors, *Complex Analysis,* (3rd Edition) McGraw Hill Book Company, New York, 1979.

CORE PAPER XIV - DIFFERENTIAL GEOMETRY

UNIT I - Curves in the plane and in space :

Curves, parametrisation, arc length, level curves, curvature, plane and space curves.
Chapters 1 and 2.

UNIT II - Surfaces in space :

Surface patches, smooth surfaces, tangents, normals, orientability, examples of surfaces, lengths of curves on surfaces, the first fundamental form, isometries, surface area.
Chapter 4 - 4.1, 4.2, 4.3, 4.4, 4.7 and Chapter 5 - 5.1, 5.2, 5.4

UNIT III - Curvature of surfaces:

The second fundamental form, Curvature of curves on a surface, normal, principal, Gaussian and mean curvatures, Gauss map.
Chapter 6 - 6.1, 6.2, 6.3 and Chapter 7 - 7.1, 7.5,7.6

UNIT IV - Geodesics :

Geodesics, geodesic equations, geodesics as shortest paths, geodesic coordinates.
Chapter 8 - 8.1, 8.2, 8.4, 8.5

UNIT V - TheoremaEgregium of Gauss :

TheoremaEgregium, isometries of surfaces, Codazzi-Mainardi equations, compact surfaces of constant Gaussian curvature.
Chapter 10

Recommended Text :

1.A. Pressley, *Elementary Differential Geometry*, Springer-Indian Edition, 2004.

CORE PAPER XV - FUNCTIONAL ANALYSIS

UNIT I: Normed spaces, Continuity of linear maps, Hahn-Banach Theorems, Banach Spaces.
Chapters II (omit sections 6.8, 7.11, 7.12, 8.4)

UNIT II: Uniform boundedness principle, Closed Graph and Open Mappingtheorems, Bounded Inverse Theorem, Spectrum of a bounded operator.
Chapter III (omit sections 9.4 to 9.7, 11.2, 11.4, 11.5, 12.6, 12.7)

UNIT III: Duals and Transposes, Weak and weak *convergence, Reflexivity
Chapter IV (omit sections 13.7, 13.8, 14, 15.5 to 15.7, 16.5 to 16.9)

UNIT IV: Inner Product Spaces, Orthonormal sets, Best approximation,Projection and RieszRepresentaion theorems.
. *Chapter VI (omit sections 23.2, 23.4, 23.6, 24.7, 24.8)*

UNIT V : Bounded operators and adjoints, Normal, unitary and self adjoint Operators, Spectrum and Numerical range, Compact selfadjoint operators
Chapter VII (omit sections 26.4, 26.5 26.6, 27.4 to 27.7, 28.7, 28.8)

Recommended Text :

1. B.V. Limaye, Functional Analysis, New Age International, 1996.

FLUID DYNAMICS

UNIT-I: Kinematics of Fluids in motion. Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.
Chapter 2. Sec 2.1 to 2.10.

UNIT-II: Equations of motion of a fluid : Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two invircid immiscible fluids- Euler's equatoin of motion - Discussion of the case of steady motion under conservative body forces.
Chapter 3. Sec 3.1 to 3.7

UNIT-III :Some three dimensional flows. Introduction- Sources, ranks and doublets - Images in a rigid infinite plane - Axis symmetric flows - stokes stream function
Chapter 4 Sec 4.1, 4.2, 4.3, 4.5.

UNIT-IV : Some two dimensional flows : Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional , irrotational in compressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem.
Chapter 5. Sec 5.1 to 5.8

UNIT-V Viscous flows: Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid.
Chapter 8. Sec 8.1 to 8.9

Recommended Text

1. F. Chorlton, *Text Book of Fluid Dynamics* ,CBS Publications. Delhi ,1985.

CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

UNIT-I: The Method of Variations in Problems with Fixed Boundaries

Chapter 6: Sections 1 to 7 (Elsgolts)

UNIT-II: Variational Problems with Moving Boundaries and certain other problems and Sufficient conditions for an Extremum

Chapter 7: Sections 1 to 4 (Elsgolts)

Chapter 8: Sections 1to 3(Elsgolts)

UNIT-III: Variational Problems Involving a conditional Extremum

Chapter 9: Sections 1 to 3. (Elsgolts)

UNIT-IV: Integral Equations with Separable Kernels and Method of successive approximations.

Chapter 1: Sections 1.1 to 1.7 (Kanwal)

Chapter 2: Sections 2.1 to 2.5 (Kanwal)

Chapter 3: Sections 3.1 to 3.5 (Kanwal)

UNIT-V: Classical FredholmTheory , Symmetric Kernels and Singular Integral Equations

Chapter 4: Sections 4.1 to 4.5 (Kanwal)

Chapter 7: Sections 7.1 to 7.6 (Kanwal)

Chapter 8: Sections 8.1 to 8.5 (Kanwal)

Recommended Text

1.For Units I,II and III : L. Elsgolts , *Differential Equations and the Calculus of variations*, Mir Publishers, Moscow, 1973 (2^{nd} Edition)

2.For Units IV and V : RamP.Kanwal,*Linear Integral Equations*, Academic Press, New York, 1971.