GURU NANAK COLLEGE
(AUTONOMOUS)

Guru Nanak Salai, Velachery, Chennai – 600 042

Re-accredited at 'A- Grade' by NAAC

(Affiliated to the University of Madras)

MASTER OF SCIENCES
DEPARTMENT OF M.Sc (MATHEMATICS)

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Regulation & Syllabus

(For the candidates admitted for the Academic year 2021-22 and thereafter)

RULES AND REGULATIONS

(Effective from the Academic Year 2021-22 and thereafter)

SEMESTER SYSTEM WITH CREDITS

I. CHOICE BASED CREDIT SYSTEM (CBCS) WITH GRADING

The College follows the CBCS with Grades under the Semester pattern. Each paper is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted.. This is done after a thorough analysis of the content of each subject paper by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job-oriented courses, Elective courses and Skill based courses as the part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience.

II. ELIGIBILITY FOR ADMISSION

Candidates admitted to the first year of the UG programme should have passed the higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

For B.Com (Hons) & B.Com (PA):

Candidates admitted to the first year of the B.Com (Hons.) & B.Com (PA) programme should have passed the higher secondary examinations conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras with 75 % cut-off in Commerce/Business studies, Accountancy, Economics and Business Mathematics/ Mathematics.

For MBA:

The basic requirement for admission to the MBA Course, is a Bachelor's degree in any discipline with a minimum of 50% marks in aggregate and satisfactory test score in MAT Entrance

Test conducted by AIMA, New Delhi / TANCET for MBA conducted by Government of Tamilnadu / CAT / XAT or any other approved MBA Entrance Tests

For MCA:

Only those candidates who have passed B.C.A/B.Sc. in Computer Science or any other equivalent degree OR passed B.Sc/B.Com/BA with Mathematics at 10 + 2 level or at graduation level (with Optional bridge course), provided they have undergone the course under 10+2+3 or 11+1+3 or 11+2+2 pattern and obtained at least 50% of marks (45 % marks in case of candidates belonging to reserved category) in the qualifying examination shall be eligible for admission to the M.C.A. Degree Course.

III. DURATION OF THE COURSE

The UG course is of three years duration with six semesters and the PG course is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students sit for the final End Semester Exam.

IV. COURSE OF STUDY

The main subjects of study for the Bachelor's Degree shall consist of the following:

1. FOUNDATION COURSES

a) PART - I : Tamil/ Hindi / Sanskrit/French

b) PART - II : English

2. CORE COURSES

a) PART - III: Consisting of (a) Main subject (b) Allied Subjects (c) Elective subjects related to the main subject of study and project work.

b) PART - IV

i. Those who have not studied Tamil / Hindi up to XII standard and have taken a non-Tamil / non – Hindi language under Part – I, shall opt for Basic Tamil / Basic Hindi in the first two semesters.

ii. Those who have studied Tamil up to XII standard, and taken a non -Tamil language under Part – I, shall opt for Advanced Tamil in the first two semesters.

iii. Others, who do not come under either of the clauses mentioned above, can choose a Non-Major Elective (NME) in the first two semesters.

iv. Soft Skills (I, II, III & IV Semesters)

v. Environmental Studies (IV Semester)

vi. Value Education (V Semester)

c) PART - V : Compulsory Extension Service

A candidate shall be awarded **one credit** for compulsory extension service.

A student must enroll in NSS / NCC /Sports & Games/ Rotaract/ Youth Red Cross / Citizen Consumer Club / Enviro Club or any other service organization in the College and should put in compulsory minimum attendance of 40 hours, which shall be duly certified by the Principal of the College. If a student lacks 40 hours compulsory minimum attendance in the extension services in any Semester, s/he shall have to compensate the same, during the subsequent Semesters. Literacy and population and educational fieldwork shall be compulsory components in the above extension service activities.

V. COURSE STRUCTURE

The UG course consists of 15-18 Core papers with 3-4 credits for each paper, 3 Elective papers and 4 Allied papers with 5 credits for each paper in addition to 3 Soft Skill papers with three credits each and one skill based subject with three credits. The B.Com (Hons) course has 31 core papers of 4 credits each and project with 8 credits and B.Com (PA) has 29 core papers.

The PG courses (M.A, M.Com, M.Sc and MSW) have 14-17 core papers with 4 credits each , Project Work with 6 credits, 5 elective papers with 3 credits, 2 extra disciplinary papers with 3 credits, Four Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits.

The MBA course has 15 core papers including project work with 4 credits, 6 elective papers with 3 credits, 2 extra disciplinary papers with 3 credits, Four Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits.

The MCA course has 15 core papers of 2-4 credits, 5 Elective papers of 3 credits, 2 Extra-disciplinary papers of 3 credits and a project work of 17 credits.

Internship training is a compulsory component for all the UG & PG courses.

❖ **The details of the course structure are given in the following table:**

CHOICE BASED CREDIT SYSTEM WITH GRADING

1. POST GRADUATE DEGREE

COMPONENTS	M.Sc. Chemistry M.Sc. Mathematics M.Sc. Zoology M.A. Economics M.A. Defence & Strategic Studies			M. COM			M. S.W		
	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits
CORE COURSES INCLUDING PRACTICAL	14-17	4	60-70	15	4	60	17	3-6	65
PROJECT	0-1	6	0 - 6	0	0	0	1	6	6
ELECTIVES	5	3 - 4	10-20	5	3	15	5	3	15
EXTRA DISCIPLINARY COURSES	2	3	6	2	3	6	2	3	6
SKILL	4	2	8	4	2	8	4	2	8
INTERNSHIP	1	2	2	1	2	2	0	0	0
TOTAL			91			91			100

COMPONENTS	M.C.A.			M.B.A.		
	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits
CORE COURSES INCLUDING PRACTICAL	15	2-4	46	13	4	52
PROJECT	1	17	17	1	8	8
ELECTIVES INCLUDING EXTRA DISCIPLINARY COURSES	7	3	21	8	3	24
SKILL	4	2	8	4	2	8
INTERNSHIP	1	2	2	1	2	2
TOTAL			94			94

2. UNDERGRADUATE DEGREE

Under Part IV of the Course, students should register separately for two Non-Major Elective papers, during the First and Second semesters. The marks obtained under Part IV will not be included for classification of the candidate although a pass is mandatory. Students should have obtained the minimum credit under Part V to be eligible to receive the degree.

PART	COMPONENTS	B.Com(Gen.) B.Com (C.S) B.Com(A&F) B.Com(B.M.) B.Com(M.M.) B.Com(ISM) B.B.A. B.C.A B.Sc (IT) B.Com(CA)			B.Sc.(Mat.) B.Sc.(Phy.) B.Sc.(Chem.) B.Sc.(Plant Bio.) B.Sc.(Adv.Zoo) B.Sc.(C.S.) B.Sc.(Viscom) B.Sc (Biotech) B.A.(Eco.) B.A.(Defence), B.A. (English). B.Sc (Data Analytics), B.A Sociology)			B.Com (Honours)			B.Com (Professional Accounting)		
		No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits
Part I Foundation Course	Language: (Tamil/ Hindi/ Sanskrit/ French)	2	3	6	4	3	12	2	3	6	2	3	6
Part II Foundation Course	English	2	3	6	4	3	12	2	3	6	2	3	6
Part III	Core Papers	15-18	3-4	72	15-18	3-4	60	31	4	124	29	4-6	123
	Project	-	-	-	-	-	-	1	8	8	-	-	-
	Allied Papers	4	5	20	4	5	20	-	-	-	-	-	-
	Elective Papers	3	5	15	3	5	15	-	-	-	1	4	4
Part IV	Non Major Electives/ Basic Tamil/ Advanced Tamil/Basic Hindi	2	2	4	2	2	4	2	2	4	2	2	4
	Soft Skill	3	3	9	3	3	9	-	-	-	3	2-4	8
	Skill Based Subject	1	3	3	1	3	3	-	-	-	-	-	-
	Environmental Studies	1	2	2	1	2	2	1	2	2	1	2	2
	Value Education	1	2	2	1	2	2	1	2	2	1	2	2
Part-V	Extension Service	1	1	1	1	1	1	1	1	1	1	1	1
	Internship	1	2	2	1	2	2	-	-	14	-	-	14
TOTAL		**142**			**142**			**167**			**170**		

VI. EXAMINATIONS

Continuous Internal Assessment (CIA) will be for 50 percent and End Semester Examination (ESE) will be for 50 percent.

➢ CONTINUOUS INTERNAL ASSESSMENT (CIA)

Every semester will have a centralized mid semester examination for each paper. This will be conducted on completion of 45 working days in each semester. A Model exam of three hours' duration will be conducted on completion of 80 working days in each semester.

The schedule for these tests is as follows:

C.I.A.Test	Schedule	Syllabus Coverage
I	After **45** working days of the Semester	50%
II (Model Examination)	After **80** working days of the Semester	95%

The components for the CIA (Theory & Practicals) are as follows:

Internal Components			
Assessment Type	**Nature**	**Maximum Marks**	**% of Weightage**
CIA	Mid Semester Exam	50	10
Model	Model Examination	100	10
	Assignment		10
	Class activity		15
	Attendance		5
Total			**50**

The class activity relates to a programme of accepted innovative techniques such as seminars, quiz, portfolio creation, MCQ, PowerPoint presentation, objective tests, role play etc. The mode of evaluation of the class activity will be fixed before the commencement of the semester and an approval will be obtained from the Head of the Department. The students will be informed of the various methods of evaluation once the semester begins.

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking.

CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty.

Marks for attendance will be awarded as per the following:

Percentage of General Attendance	Marks Awarded
90-100	5
75-89	4
60-74	3
<60	0

- **END SEMESTER EXAMINATIONS (ESE)**

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG courses will be held for all papers in November/December and April/May

Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practicals will be notified by the Controller of Examinations in consultation with the Dean (Academics).

A candidate will be permitted to appear for the End Semester examinations for any semester if:

a) S/he secures not less than 75% of attendance in the working days during the semester.
b) S/he should have applied for the examination
c) S/he should have paid the requisite examination fee
d) Her/His overall conduct has been satisfactory

The attendance requirements to appear for the ESE are as follows:

i. Students must have **75% of attendance in each part of the course of study to appear for the End Semester Examination.**

ii. Students who have **65% to 74.9% of attendance shall apply for condonation** in the prescribed form along with the prescribed fee after obtaining permission from the Principal. Students cannot claim condonation as a matter of right. Submission of Medical Certificate is normally not accepted to condone shortage of attendance.

iii. Students who have 50% to 64.9% of attendance will fall under the - **Withheld category**. Such students cannot take up the ESE exams. They should apply to the Principal for permission to write the next supplementary examination and pay the requisite fee for this purpose. However, they can appear for the supplementary examinations for the previous semester's paper/s.

iv. Students who have less than 50% of attendance fall under the **Detained category- They will not be permitted to appear for the examination. They shall redo the semesters after completion of the course and appear for the examination after securing the required percentage of attendance. The decision of the Principal remains final and binding in all respects.**

v. Students who do not get the minimum marks to pass in the ESE shall compulsorily re-appear for the paper in the subsequent semester after paying the required fee.

A Student who, for whatever reasons is not able to complete the program within the normal period (N) or the minimum duration prescribed for the programme, may be allowed a two year period beyond the normal period of study to clear the backlog to be qualified for the degree. (Time Span = N +2 years for the completion of programme).

In exceptional cases like major accidents and childbirth an extension of one year may be considered beyond the maximum span of time (Time Span = N + 2 + 1 years for the completion of programme).

If the students fail to complete the course and take the examination within the stipulated time, they will be required to re-register their names and take the examination in the revised regulations/syllabus of the paper in force at the time of their reappearance. Students qualifying during the extended period shall not be eligible for **RANKING.**

- **INSTANT EXAMINATION (SPECIAL SUPPLEMENTARY EXAMINATION)**

In order to provide an opportunity to the final year UG and PG students to obtain the degree in the same year and also to facilitate vertical mobility, special supplementary End Semester Examinations will be conducted in about 30 days from the date of publication of results every year for the final semester theory papers and also for the candidates who had failed in **ONLY ONE** theory paper of the previous semesters. Students, who wish to apply for special supplementary End Semester Examinations, can do so within 7 days from the date of publication of results.

Students involved in Malpractice will not be permitted to appear for Supplementary Examination.

The details of the ESE are as follows:

External Component			
Assessment type	**Comprehensive Test**	**Maximum mark**	**% of Weightage**
External Exam	3 Hours Examination	100	50
	Grand Total (CIA+ESE)		100

VII. CONDUCT OF EXAMINATION

The Chief Superintendent of Examinations will be the Principal or a person appointed by the Principal. The responsibility of conducting the End Semester Examinations lies with the team led by the Chief Superintendent.

The time-table for examinations will be finalized by the office of the Controller of Examinations and will be displayed well in advance i.e., 20 days prior to the commencement of the examinations.

The Hall tickets for eligible students will be issued 3 days prior to the commencement of examinations. For Subjects like Environmental Studies / Value Education, End Semester Examinations may be conducted either in the on-line mode or in the offline mode along with the regular ESE.

VIII. VALUATION

The valuation of the answer scripts will be undertaken at the central valuation camp led by the Controller of Examinations or the Camp Officer appointed by the Controller of Examinations. Double valuation of answer scripts is adopted for both UG and PG Courses.

IX. PUBLICATION OF RESULTS

The Examination results will be published on the web portal during the third / fourth week of May for the II, IV and VI semester examinations and during the third / fourth week of December for the I, III and V semester examinations

A. GUIDELINES FOR OBTAINING PHOTOCOPY OF THE ANSWER SCRIPT

Candidates seeking photocopy of the answer scripts are advised to go through these rules and regulations before applying.

i. Photocopy is permitted only for Regular theory papers in PART I, II and III. **(Supplementary excluded).**

ii. The student should carefully select the papers for which s/he wishes to obtain the photocopy. A second application will not be accepted for additional papers.

B. GUIDELINES FOR APPLYING FOR REVALUATION OF THE ANSWER SCRIPT

Candidates seeking revaluation are advised to go through these rules and regulations before applying.

i. Revaluation is permitted only for Regular theory papers in PART I, II and III. **(Supplementary excluded).**

ii. The student should carefully select the papers for which s/he wishes to apply for revaluation. A second application will not be accepted for additional papers.

iii. The application is to be filled in by the candidate in his/her own hand-writing and not by anyone else on his/her behalf.

iv. Entries made by the candidate are to be verified by the HOD and forwarded to the Principal for endorsement.

v. The prescribed Fee payment receipt or challan has to be attached along with the Application Form and submitted to the Principal's Office. The candidate will be given an acknowledgement for submission, with date and time.

vi. The candidate has to be aware that when s/he is applying for revaluation, S/he **SURRENDERS** the original performance and will now accept the revised performance in which there could either be a **CHANGE/ NO CHANGE** in the marks.

X. CLASSIFICATION OF PERFORMANCE – GRADING SYSTEM FOR THE SEMESTER

A candidate shall be declared to have qualified for the award of the Degree, provided the candidate has successfully completed the Programme requirements and has passed all prescribed subjects of study in the respective semesters.

Passing Minimum: UG CIA 40% AGGREGATE 40% B.Com (Hons.) and PG CIA 50% ESE 50% AGGREGATE 50% OF THE MAXIMUM OF THE COMPONENT IN THAT PAPER / COURSE

P: Pass, U: Re-Appear, WH: Withheld, AAA: Absent, CIA: Continuous Internal Assessment, ESE: End Semester Examination, GPA: Grade Point Average.

CGPA: Cumulative Grade Point Average

POST GRADUATE DEGREE

PART – A: Core, Elective including Extra Disciplinary Elective, Major Project

PART – B: Soft Skills, Internship

UNDERGRADUATE DEGREE

PART – I : Tamil / Hindi/Sanskrit/French

PART – II : English

PART – III: Core, Allied, Elective and Inter Disciplinary Elective

PART – IV: Basic/Advanced Tamil / Basic Hindi/ Non-Major Elective, Skill Based Electives, Environmental Studies and Value Education

PART – V : Extension Activities

RANGE OF MARKS FOR GRADES UG Also for Certificate / Diploma				RANGE OF MARKS FOR GRADES UG[B.Com.(Hons.) B.Com (PA)], PG and also			
Range of Marks	**Grade Points**	**Letter Grade**	**Description**	**Range of Marks**	**Grade Points**	**Letter Grade**	**Description**
90 - 100	9.0 - 10.0	O	Outstanding	90 - 100	9.0 - 10.0	O	Outstanding
80 - 89	8.0 - 8.9	D+	Excellent	80 - 89	8.0 - 8.9	D+	Excellent
75 - 79	7.5 - 7.9	D	Distinction	75 - 79	7.5 - 7.9	D	Distinction
70 - 74	7.0 - 7.4	A+	Very Good	70 - 74	7.0 - 7.4	A+	Very Good
60 - 69	6.0 - 6.9	A	Good	60 - 69	6.0 - 6.9	A	Good
50 - 59	5.0 - 5.9	B	Average	50 - 59	5.0 - 5.9	B	Average
40 - 49	4.0 - 4.9	C	Satisfactory	00 - 49	0.0 - 4.9	U	Re-appear
00 - 39	0.0 - 3.9	U	Re-appear	ABSENT	0	AAA	Absent
ABSENT	0	AAA	Absent				

C*i*= Credits earned for course *i* in any semester

G*i*= Grade Point obtained for course *i* in any semester

n refers to the semester in which such courses were credited.

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

B.Com (Hons.)	**UG**	**B.Com (Hons.), B.Com (PA)**	**B.Com (Hons.) B.Com (PA)**	**UG**	**UG**
0.0 and above but below 5.0	4.5 and above but below 5.0	U	Re-appear	C +	Third Class
	4.0 and above but below 4.5			C	
	0.0 and above but below 4.0			U	Re-appear

- **CGPA Grades:**

The candidates who have passed in the first appearance and within the prescribed semester of the UG/PG Programme (Core, Allied and Elective) alone are eligible for classification of results.

GRADING SYSTEM

For a Semester:

GRADE POINT AVERAGE [GPA] = $\sum_i C_i G_i / \sum_i C_i$

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

For the entire programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA] = $\sum_n \sum_i C_{ni} G_{ni} / \sum_n \sum_i C_{ni}$

$$CGPA = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

(CGPA is calculated only if the candidate has passed in all the courses in the entire programme)

XI. CONCESSIONS FOR DIFFERENTLY-ABLED STUDENTS

A. DYSLEXIA STUDENTS

For students who are mentally challenged/who have a learning disability and mental retardation/ who are slow learners/ who are mentally impaired/ who have learning disorder and seizure disorder/ who are spastic and those who have cerebral Palsy, the following concessions shall be granted:

i. **Part I** Foundation course in Tamil/Hindi/Sanskrit/French **can be exempted**.
ii. **One-third** of the time meant for the paper may be given as **extra time** in the examination.
iii. **Leniency** in overlooking **spelling mistakes**, and
iv. **Amanuensis** for all courses will be provided on request. This will be acceptable only if the request is duly certified by the Medical Board of the Government Hospital/ General Hospital/ District headquarters Hospitals and they shall be declared qualified for the degree if they pass the other examinations prescribed for the degree.

B. HEARING, SPEECH IMPAIRED & MENTALLY CHALLENGED

For students who are hearing and speech impaired/who are mentally challenged, the following concessions shall be granted:

i. **One Language paper** either **Part I** Foundation course Tamil/Hindi/Sanskrit/French or **Part II** English or its equivalent **can be exempted**
ii. **Part IV** Non-Major Elective (NME) or Basic Tamil/Advanced Tamil or Basic Hindi **can be exempted.**

C. VISUALLY IMPAIRED STUDENTS:

i. Exempted from paying **examination fees.**

ii. A scribe shall be **arranged by the College** and the scribe will be paid as per the College's decision.

XII. INTERDISCIPLINARY ELECTIVE (IDE)

It has been proposed that the UG students admitted from the academic year 2021 – 22 onwards would take up an Interdisciplinary Elective (IDE) Paper in their **Fifth Semester**.

❖ **The following Departments functioning in Shift I will offer IDE Papers to students only from Shift I:**

S.NO	DEPARTMENT	IDE (TITLE OF THE PAPER)
1.	B.A Economics	Principles of Insurance and Risk Management
2.	B.A Defence & Strategic Studies	An Introduction to Defence Journalism
3.	B.Sc Mathematics	Numerical Analysis
4.	B.Sc Physics	Introduction to Integrated Electronics
5.	B.Sc Chemistry	Chemistry in Everyday life
6.	B.Sc Plant Biology & Biotechnology	Horticulture & Mushroom Cultivation
7.	B.Sc Advanced Zoology & Biotechnology	Wildlife Conservation
8.	B.Com (General)	Entrepreneurial Development -1
9.	B.Com Corporate Secretaryship	Entrepreneurial Development -2

❖ **The following Departments functioning in Shift II will offer IDE Papers to students only from Shift II:**

S.NO	DEPARTMENT	IDE (TITLE OF THE PAPER)
1.	B.B.A	Managerial Skill Development
2.	B.C.A	E - Commerce
3.	B.Com (A&F)	Indian Constitution and Human Rights
4.	B.Com (General)	Entrepreneurial Development -3
5.	B.Com (Corp. Sec)	Entrepreneurial Development -4
6.	B.Sc Computer Science	Internet and Its Applications
7.	B.Sc Visual Communication	Understanding Film
8.	B.Com (BM)	Personal Investment Planning
9.	B.Com (MM)	Tourism Management

❖ **The following Departments from Shift II, functioning in Shift I timings can only offer IDE Papers to the students functioning within the same Shift I timings:**

S.NO	DEPARTMENT	IDE (TITLE OF THE PAPER)
1.	B.Com (ISM)	Essentials of Office Automation Tools and E- Mail Etiquette
2.	B.A English Literature	Travel Writing
3.	B.Sc Biotechnology	Intellectual Property Rights
4.	B.Sc Information Technology	Web Designing
5.	B.Sc Data Analytics	• Interdisciplinary Elective – Digital Logic Fundamentals • Operating Systems • Data Visualization using Tableau • Pentaho/ Looker
6.	Commerce (PA)	Office Management & Methods
7.	Commerce (CA)	• Entrepreneurial Development • Production & Supply Chain Management • Business Information System
8.	B.A Sociology	Problems of Urban India
9.	B.A Defence & Strategic Studies	An Introduction to Defence Journalism

XIII. OPTION TO EARN ADDITIONAL CREDITS

A. MOOCs (Massive Open Online Courses)

- The UG students can opt for a minimum of one Course and earn 2 credits, while a maximum of 6 Credits can be earned by completing three courses during their three-year period of study.
- The PG students can opt for a minimum of one Course and earn 2 credits, while a maximum of 4 Credits can be earned by completing two courses during their two-year period of study.
- This is completely optional.

B. CERTIFICATE COURSES

The Certificate courses are offered by the departments for 30 hours which will enable the students to earn 2 additional credits.

C. ADDITIONAL CREDIT FOR EXTENSION SERVICES

All the students who have put in additional 40 hours or more apart from the compulsory minimum hours in NSS / NCC / Sports & Games / Rotaract / Youth Red Cross / Citizen Consumer Club / Enviro Club or any other service organization in the College will be eligible to earn an additional credit at the time of completion of their Course. This should be duly certified by the Principal of the College,

XIV. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS

i. All candidates should register their names for the first semester examination after admission to the UG / PG courses.

ii. Candidates shall be permitted to proceed from the first semester up to the final semester irrespective of their failure in any of the semester examinations, subject to the condition that the candidate had registered for all the arrear subjects of earlier semesters along with current semester subjects.

XV. ISSUE OF CERTIFICATES

A Statement of Marks will be issued to each student who has written the examination.

- **Consolidated Mark Sheet**

  Consolidated mark sheets will be given to final year students along with total credits earned only to those who have passed in all the papers prescribed for the respective degree.

- **Transcript**

  Students who wish to obtain any Transcript for joining courses of study in other Universities in India or abroad or for obtaining scholarships, can obtain these certificates from the office of the Controller of Examinations. A requisition letter duly signed by the Student and forwarded by the Principal along with fee challan is to be submitted to the office of the Controller of Examinations. The Certificate will be provided within 15 working days in a sealed envelope.

- **Provisional Certificate**

  A copy of the results of the successful final year students will be sent to the University of Madras in the prescribed format in July/August and the University will issue a Provisional Certificate through the College. A soft copy can be downloaded from the University of Madras website and a hard copy will be provided by them within 90 days of the issue of the soft copy.

- **Corrections in the Certificates**

  Any corrections like name, date of birth etc., can also be made in the certificate. A letter of request duly signed by the student, HOD and Principal along with the prescribed fee paid challan has to be forwarded to the office of the Controller of Examinations. The details will be updated within 15 working days. The amount once paid will not be refunded under any circumstances.

- **Duplicate Mark Sheet**

  In case of loss of the mark sheet / certificate, a duplicate will be provided after submitting a non-traceable certificate issued from the Police station duly signed by an Inspector or Sub Inspector. A letter of request duly signed by the student, HOD and Principal along with the prescribed fee paid challan is to be forwarded to the office of the Controller of Examinations.

❖ **Duplicate Provisional Certificate / Degree Certificate:**

Students have to apply directly to the University of Madras for duplicate provisional certificate and degree certificate.

❖ **Verification of Qualification**

Agencies which request for verification of educational qualification of students under the autonomous mode of this college and students who opt for higher studies / employment and who require verification of educational qualification shall verify online through the QR code in the consolidated mark sheet after an online payment of fees for the same. They can also apply to the Principal to this effect along with the prescribed fees which has to be forwarded to the Office of the Controller of Examination. The relevant certificate will be issued within 15 working days from the receipt of the forwarded request of the Principal and the Office of the Controller of Examination.

XVI. CONVOCATION AND NOTICE

❖ **Convocation**

Every year after the Convocation is conducted by the University of Madras, the College will hold a Graduation day / Convocation in which the Degree Certificates will be distributed to the students who are present. For others it will be issued by the College Office. Students should collect the same within 30 days of convocation after which a search fee will be charged. **Students are responsible for collecting their Degree certificates from the college office on time.**

❖ **Notice**

Candidates, who have completed the duration of the course and left the College, can get information regarding Supplementary Examinations, issue of examination application forms, certificates and application for Graduation day through the college website and general notice board. Regular students will however be informed of the examinations by circulation, in addition to the modes mentioned above.

No student will receive individual communication.

XVII. PROCEDURE FOR SUBMISSION OF SYLLABUS

i. Each department will finalize the syllabus.

ii. Finalization could mean a minor change in the existing syllabus or a revamp of the entire syllabus.

iii. The department will submit the changes to the Board of Studies. After the approval of the syllabus in the BOS, the concerned department will submit the minutes along with the modified syllabus book / sheet (five copies) to the Dean's office within ten days of the BOS meeting.

iv. A Soft copy of the batch-wise syllabus approved by the BOS in PDF format should be sent to the Dean's mail ID within ten days of the BOS meeting.

COURSE STRUCTURE

M.Sc. Mathematics

Academic year 2021-2022 and thereafter

Semester	Course Title		Hours	Credits	Marks		
					Internal	External	Total
Semester -I	Core –I	Algebra-I	6	4	50	50	100
	Core –II	Real Analysis-I	6	4	50	50	100
	Core –III	Ordinary Differential Equations	6	4	50	50	100
	Core –IV	Operations Research	6	4	50	50	100
	Elective –I	Object Oriented Programming with C++/ Number Theory and Cryptography	4	3	50	50	100
	Soft Skills –I	Personality Enrichment Skills	2	2	50	50	100
Semester -II	Core –V	Algebra-II	6	4	50	50	100
	Core –VI	Real Analysis-II	6	4	50	50	100
	Core –VII	Partial Differential Equations	6	4	50	50	100
	Core –VIII	Probability Theory	6	4	50	50	100
	Elective –II	Practical for Programming with C++ / Difference Equations	3	3	50	50	100
	Extra Disciplinary Elective – I	Numerical Methods / Quantitative Aptitude	3	3	50	50	100
	Soft Skills –II	Workplace communication Skills	2	2	50	50	100
Semester -III	Core –IX	Complex Analysis	7	4	50	50	100
	Core –X	Topology	6	4	50	50	100
	Core –XI	Mechanics	6	4	50	50	100
	Elective –III	Stochastic Processes / Algebraic Theory of Numbers	6	3	50	50	100
	Extra Disciplinary Elective –II	Statistical Methods / Logical Reasoning for Competitive Exams	3	3	50	50	100
	Soft Skills –III	Self & Time Management Skill	2	2	50	50	100
		Summer Internship	-	2	-	-	-
Semester -IV	Core –XII	Calculus of Variations and Integral Equations	5	4	50	50	100
	Core –XIII	Differential Geometry	5	4	50	50	100
	Core –XIV	Functional Analysis	5	4	50	50	100
	Core Paper-XV	Project	4	4	50	50	100
	Elective Paper –IV	Graph Theory / Mathematical Statistics	6	3	50	50	100
	Elective Paper –V	Fuzzy sets and their Applications / Algebraic Topology	3	3	50	50	100
	Soft Skills -IV	Spoken and Presentation Skills	2	2	50	50	100
TOTAL			**91**				

END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS

ALLOTMENT OF QUESTIONS	**MAXIMUM :100 MARKS** **PASSING MINIMUM :50 MARKS** **DURATION : 3 HOURS**
QUESTION NUMBERS 1-12 Answer any 10 Questions out of 12 Questions	PART-A(10×3=30MARKS) Each Question carries 3 Marks.
QUESTION NUMBERS 13-19 Answer any 5 Questions out of 7 Questions	PART- B(5×6=30MARKS) Each Question carries 6 Marks.
QUESTION NUMBERS 20-25 Answer any 4 Questions out of 6 Questions	PART- C (4×10=40MARKS) Each Question carries 10 Marks.

SEMESTER - I

CORE I: ALGEBRA – I

COURSE CODE :	THEORY	100 MARKS
SEMESTER: I	CREDITS: 4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

Group Theory: Another Counting Principle-Sylow's Theorems

Chapter 2: Section 2.11 & 2.12

UNIT-II **(18hrs)**

Group Theory: Direct Products-Finite Abelian Groups

Vector Spaces and Modules: Modules

Chapter 2: Sections 2.13 & 2.14,

Chapter 4: Section 4.5

UNIT-III **(18hrs)**

Linear Transformations: - Canonical Forms: Triangular Form.-
Nilpotent Transformations.

Chapter 6: Sections 6.4 & 6.5

UNIT-IV **(18hrs)**

Linear Transformations: Canonical Forms: A Decomposition of V Jordan
Form - Rational Canonical Form

Chapter 6: Sections 6.6 & 6.7

UNIT-V: **(18hrs)**

Linear Transformations: Trace and transpose - Hermitian,
Unitary and Normal Transformations- Real Quadratic Forms.

Chapter 6 : Sections 6.8, 6.10 & 6.11

PRESCRIBED TEXTBOOK:

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

REFERENCE BOOKS:

1. M. Artin, Algebra, Prentice Hall of India,1991.
2. P. B. Bhattacharya, S. K. Jain, and S.R. Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I. S. Luther and I. B. S. Passi, Algebra, Vol. I - Groups(1996); Vol. II Rings(1999), Narosa Publishing House , New Delhi
4. D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd edition, Wiley,2002.
5. N. Jacobson, Basic Algebra, Vol. I & II W. H. Freeman (1980); also published by Hindustan Publishing Company,New Delhi.

CORE II: REAL ANALYSIS –I

COURSE CODE:	THEORY	100 MARKS
SEMESTER: I	CREDITS: 4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

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.

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

Chapter 6: Sections 6.1 to 6.8

Chapter 8 : Sections 8.8 & 8.15

UNIT-II **(18hrs)**

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 7.7 & 7.10 to 7.14

UNIT-III **(18hrs)**

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-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign- Lebesgue's criterion for the existence of Riemann integrals.

Chapter - 7: Sections 7.15 to 7.24 &7.26

UNIT-IV **(18hrs)**

Infinite Series and infinite Products: - Multiplication of series –Cesaro summability - Infinite products.

Sequence of Functions: 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 8:** Sections 8.24 to 8.26

Chapter 9: Sections 9.14, 9.15, 9.19, 9.20, 9.22, 9.23

UNIT-V **(18hrs)**

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- uniformly Convergence sequences that can be integrated Term-by-term Integration - Uniform convergence and differentiation - Sufficient conditions for uniform convergence of a series.

Chapter 9: Sec 9.1 to 9.6, 9.8, 9.9, 9.10, 9.11

PRESCRIBED TEXTBOOK:

Tom M. Apostol: Mathematical Analysis, 2nd Edition, Narosa,1989.

REFERENCE BOOKS:

1. Bartle. R. G, Real Analysis, John Wiley and Sons Inc.,1976.
2. Rudin. W, Principles of Mathematical Analysis, 3rd Edition. McGraw HillCompany, New York,1976.
3. Malik. S. C, and SavitaArora. Mathematical Analysis, Wiley Eastern Limited.New Delhi,1991.
4. Sanjay Arora and BansiLal, Introduction to Real Analysis, SatyaPrakashan,New Delhi,1991.
5. Gelbaum. B. R, and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco,1964.
6. A. L. Gupta and N. R. Gupta, Principles of RealAnalysis, Pearson Education, (Indian print)2003.

CORE – III: ORDINARY DIFFERENTIAL EQUATIONS

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: I	**CREDITS:4**	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18 hrs)**

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 **(18hrs)**

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 to11.

UNIT-III **(18hrs)**

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

UNIT-IV **(18hrs)**

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

Chapter 4: Sections 3, 4 ,6 ,7 & 8

UNIT-V **(18hrs)**

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

PRESCRIBED TEXTBOOK:

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

REFERENCE BOOKS:

1. Williams E. Boyce and Richard C. Di Prima, Elementary differentialequations andboundary value problems,John Wiley and sons, New York,1967.
2. George F Simmons, Differential equations with applications and historicalnotes, Tata McGraw Hill, New Delhi,1974.
3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W. T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M. D. Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi2001.

CORE IV: OPERATIONS RESEARCH

COURSE CODE:	THEORY	100 MARKS
SEMESTER: I	CREDITS: 4	NO. OF HOURS PER WEEK:6

UNIT-I **(18hrs)**

Integer Linear Programming: Illustrative- Applications Integer programming algorithm– Branch and Bound algorithm – Cutting plane algorithm.

Chapter 9: Sections. 9.1 & 9.2

UNIT-II **(18 hrs)**

Deterministic Dynamic Programming: Recursive nature of computation in DP – Forward and Backward recursion. Selected DP application – Cargo Loading model – Work force size model – Problem of dimensionality.

Chapter 12: Sections 12.1, 12.2, 12.3.1, 12.3.2, 12.4.

UNIT-III **(18 hrs)**

Deterministic Inventory Control Models: General inventory model – static EOQ model – classical EOQ model – EOQ with price breaks – Multi item EOQ with storage limitation.

Chapter 13: Sections 13.1 and 13.3

UNIT-IV **(18 hrs)**

Queueing Systems: Elements of a queueing model – Specialized Poisson Queues – Steady state measures of performance – Single server models – Multiple server models.

Chapter 18: Sections. 18.2, 18.6.1, 18.6.2, 18.6.3.

UNIT-V **(18 hrs)**

Nonlinear programming algorithm: Unconstrained algorithm – Direct search method – Gradient method – Constrained algorithm – Separable programming – Quadratic programming.

Chapter 21: Sections. 21.1, 21.2: 21.2.1, and 21.2.2.

PRESCRIBED TEXTBOOK:

Operations Research An Introduction by Hamdy A.TAHA, Ninth edition.

REFERENCE BOOKS:

1.J.K.Sharma, Operations Research Theory and Applications 5th Edition ,Macmillon Publishers India Ltd 2013

2.F.S. Hiller and J.Lieberman -,Introduction to Operations Research (7th Edition), Tata McGraw Hill Publishing Company, New Delhui, 2001.

3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979

4. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall , Linear Programming and Network flow, John Wiley and sons, New York 1990.

5. Gross, D and C.M.Harris, Fundamentals of Queueing Theory, (3rd Edition), Wiley and Sons, New York, 1998.

ELECTIVE – I: (A) OBJECT ORIENTED PROGRAMMING WITH C++

COURSE CODE:	THEORY	100 MARKS
SEMESTER: I	CREDITS: 3	NO. OF HOURS PER WEEK: 4

UNIT-I **(12 hrs)**

Principles of object oriented programming: Basic concepts of object oriented programming.

Beginning with C++ : Structure of C++ Program.

Tokens, Expressions and Control Structure : Reference Variables- Operators – Manipulators – Expressions and their types -Control Structures

Functions in C++: Main Function – Function Prototyping- Default Arguments - Function Overloading.

Chapter 1: Section 1.5.

Chapter 2: Section 2.6.

Chapter 3: Sections 3.12, 3.13, 3.17, 3.19 & 3.24.

Chapter 4: Sections 4.2, 4.3, 4.7 & 4.9.

UNIT-II **(12 hrs)**

Classes and Objects : Specifying a Class – Defining Member Functions – A C++ Program with Class – Static Data Members– Static Member Functions – Arrays of Objects – Objects as Function – Arguments – Friendly Functions – Returning Objects. **Chapter 5:** Sections 5.3, 5.4, 5.5, 5.11, 5.12, 5.13, 5.14, 5.15 & 5.16

UNIT-III **(12 hrs)**

Constructors and Destructors: Parameterized Constructors – Multiple Constructors in a Class

– Copy Constructors – Destructors

Operator Overloading and Type Conversions: Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Using Friend Function – Rules for Overloading Operators

Chapter 6: Sections 6.3, 6.4, 6.7,
6.11 **Chapter 7:** Sections 7.2, 7.3,
7.4, 7.5, 7.7

UNIT-IV **(12 hrs)**

Inheritance: Defining Derived Classes – Single Inheritance – Multilevel Inheritance – Multiple inheritance – Virtual Base Classes

Pointers: Pointers to Objects – this pointer – Pointer to Derived Classes – Virtual Functions and Polymorphism – Pure Virtual Function

Chapter 8: Sections 8.2, 8.3, 8.5, 8.6, 8.9

Chapter 9: Sections 9.3, 9.4, 9.5, 9.6, 9.7

UNIT-V **(12 hrs)**

Managing Console I/O Operations : C++ Streams – C++ Stream Classes – **Working with Files:** Classes for File Stream Operations – Opening and Closing a File – Detecting End-of- File – File Modes.

Chapter 10: Sections 10.2 & 10.3

Chapter 11: Sections 11.2, 11.3, 11.4 & 11.5

PRESCRIBED TEXTBOOK:

E.Balagurusamy, Object Oriented Programming with C++,Tata McGraw Hill, New Delhi, 2006.

REFERENCE BOOK:

Ravichandran, Programming with C++, Tata McGraw Hill, New Delhi, 1996

ELECTIVE – I: (B) COURSE TITLE: NUMBER THEORY AND CRYPTOGRAPHY

COURSE CODE:	THEORY	100 MARKS
SEMESTER: I	CREDITS: 3	NO. OF HOURS PER WEEK: 4

UNIT-I **(12 hrs)**

Elementary Number Theory: Time Estimates for doing arithmetic – divisibility and Euclidean algorithm

Chapter 1: Sections 1 & 2

UNIT-II **(12 hrs)**

Elementary Number Theory : Congruences – Some applications to factoring

Chapter 1 : Sections 3 & 4

UNIT-III **(12 hrs)**

Finite Fields and Quadratic Residues: Finite Fields-Quadratic residues and reciprocity.

Chapter 2: Sections 1 & 2

UNIT-IV **(12 hrs)**

Cryptography : Some simple cryptosystems Enciphering matrices

Chapter 3 : Sections 1 and 2.

UNIT-V **(12 hrs)**

Public Key : Public Key Cryptography - RSA

Chapter 4 : Sections 1 and 2

PRESCRIBED TEXTBOOK:

Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987

REFERENCE BOOKS:

1. I. Niven and H.S.Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi,1976
2. David M.Burton, Elementary Number Theory, Brown Publishers, Iowa,1989
3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag,1972
4. N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998

SEMESTER - II

CORE- V: ALGEBRA – II

COURSE CODE :	THEORY	100 MARKS
SEMESTER: II	CREDITS: 4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

Fields: Extension fields -The Transcendence of e.

Chapter 5: Sections 5.1& 5.2

UNIT-II **(18hrs)**

Fields: Roots of Polynomials- More about roots

Chapter 5: Sections 5.3 & 5.5

UNIT-III **(18hrs)**

Fields: Elements of Galois theory:

Chapter 5: Section 5.6

UNIT-IV **(18hrs)**

Selected Topics: Finite fields - Wedderburn's theorem on finite division rings

Chapter 7: Sections 7.1 & 7.2 (Theorem 7.2.1 only)

UNIT-V **(18hrs)**

Fields: Solvability by radicals–Galois groups over the rational

Selected Topics: A theorem of Frobenius.

Chapter 5: Sections 5.7 & 5.8

Chapter 7: Sections 7.3

PRESCRIBED TEXTBOOK:

I. N. Herstein. Topics in Algebra (II Edition) Wiley2002

REFERENCE BOOKS:

1. M. Artin, Algebra, Prentice Hall of India,1991.
2. P. B. Bhattacharya, S. K. Jain, and S. R. Nagpaul, Basic Abstract Algebra(II Edition) Cambridge University Press, 1997. (Indian Edition)
3. S. Luther and I. B. S. Passi, Algebra, Vol. I - Groups(1996); Vol. II Rings, (1999) Narosa Publishing House , New Delhi.
4. S. Dummit and R. M. Foote, Abstract Algebra, 2nd edition, Wiley,2002.
5. N. Jacobson, Basic Algebra, Vol. I & II Hindustan Publishing Company, New Delhi.

CORE VI: REAL ANALYSIS – II

COURSE CODE :	THEORY	100 MARKS
SEMESTER: II	CREDITS:4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

Measure on the Real line: Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability

Chapter 2: Sections 2.1 to 2.5 of Book [1]

UNIT-II **(18hrs)**

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

Chapter 3: Sections 3.1,3.2 & 3.4 of Book [1]

UNIT-III **(18hrs)**

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 Theorem - 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 of Book [2]

UNIT-IV **(18hrs)**

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 Rn to R1

Chapter 12 : Section 12.1 to 12.14 of Book [2]

UNIT-V **(18hrs)**

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 of Book [2]

PRESCRIBED BOOKS:

1. G. de Barra, Measure Theory and Integration, New Age International,2003
2. Tom M. Apostol : Mathematical Analysis, 2nd Edition, Narosa 1989

REFERENCE BOOKS:

1. Burkill,J.C. The Lebesgue Integral, Cambridge University Press,1951.
2. Munroe,M.E. Measure and Integration. Addison-Wesley,Mass.1971.
3. Royden,H.L.Real Analysis, Macmillan Pub. Company, New York,1988.
4. Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York, 1979.
5. Malik,S.C. and SavitaArora. Mathematical Analysis, Wiley Eastern Limited. New Delhi,1991.

CORE- VII: PARTIAL DIFFERENTIAL EQUATIONS

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: II	**CREDITS: 4**	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18hrs)**

Fundamental Concepts : Introduction – Classification of Second Order PDE – Canonical Forms: Canonical Form for Hyperbolic Equation , Canonical Form for Parabolic Equation , Canonical Form for Elliptic Equation.

Chapter 1: Section: 1.1 to 1.3

UNIT-II **(**18**hrs)**

Elliptic Differential Equations : Occurrence of the Laplace and Poisson Equations: Derivation of Laplace Equation, Derivation of Poisson Equation. Boundary Value Problem (BVPs) – Some important Mathematical tools - Separation of Variables – Dirichlet Problem for a Rectangle - The Neumann Problem for a rectangle - Interior Dirichlet Problem for a Circle – Exterior Dirichlet Problem for a Circle– Interior Neumann Problem for a Circle.

Chapter 2: Section: 2.1 to 2.3, 2.5 to 2.10

UNIT-III **(**18**hrs)**

Parabolic Differential Equations : Occurrence of The Diffusion Equation –Boundary Conditions – Elementary Solutions of the Diffusion Equation – Dirac Delta Function – Separation of Variables Method.

Chapter 3: Section: 3.1 to 3.5

UNIT-IV **(**18**hrs)**

Hyperbolic Differential Equations : Occurrence of the Wave Equation – Derivation of One- dimensional Wave Equation – Solution of One-dimensional Wave Equation by Canonical Reduction – The Initial Value Problem ; D'Alembert's Solution – Vibrating String : Variables Separable Solution.

Chapter 4 : Section: 4.1 to 4.5

UNIT-V **(**18**hrs)**

Green's Function : Introduction- Green's function for Laplace equation – the methodsof Images – the eigenfunction method – Green's function for the wave equation: Helmholtz theorem.

Chapter 5 : Section: 5.1.to 5.5.

PRESCRIBED BOOK :

Introduction to Partial Differential Equations by K. Sankara Rao , Third Edition,
PHI Learning Private Limited.

REFERENCE BOOKS:

1. R.C Mc.Owen, Partial Differential Equations, II ed., Pearson Education. New Delhi,2005.
2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hil, News Delhi,1983.
3. R. Dennemeyer, Introduction to Partial Differential Equations and
BoundryValue Problems, McGraw Hill, New York,1968.
4.T.Amarnath, Partial Differential Equations, NarosapublishingHouse

CORE –VIII: PROBABILITY THEORY

COURSE CODE :	THEORY	100 MARKS
SEMESTER: II	CREDITS: 4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

Random Events and Random Variables: Preliminary remarks-Random events and operations performed on them- Probability axioms – Application of Combinatorial formulae for computing probabilities – Conditional probability– Bayes Theorem – Independent events **Random Variables:** Concepts of a random variable- Distribution Function –Random variables – Functions of random variable- Multi dimensional random variable- Marginal Distribution – Conditional Distribution – Independent random variables – Functions of Multi dimensional random variables.

Chapter 1: Sections 1.1 to 1.7

Chapter 2 : Sections 2.1 to 2.9

UNIT-II **(18hrs)**

Parameters of the Distribution: Expected values- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors.

Chapter 3 : Sections 3.1 to 3.6

UNIT-III **(18hrs)**

Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – Semi-Invariants – Characteristic function of the sum of the independent random variables– Determination of distribution function by the Characteristic function– Characteristic function of multidimensional random vectors.

Chapter 4 : Sections 4.1 to 4.6

UNIT-IV **(18hrs)**

Some Probability distributions: One point and two point distribution –Binomial distribution – Polya and Hypergeometric distribution – Poisson (discrete) distributions – Uniform – normal - gamma distributions.

Chapter 5 : Section 5.1 to 5.8

UNIT-V **(18hrs)**

Limit Theorems : Preliminary remarks- 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- Lapunov Theorem

Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9

PRESCRIBED TEXTBOOK:

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

REFERENCE BOOKS:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York,1972
2. K.L.Chung, A course in Probability, Academic Press, New York,1974.
3. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York,1996.
4. V.K.Rohatgi ,An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rdPrint).
5. S.I.Resnick, A Probability Path, Birhauser,Berlin,1999.
6. B.R.Bhat , Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi,1999

ELECTIVE – II: (A) PRACTICAL FOR PROGRAMMING WITH C++

COURSE CODE :	PRACTICAL	100 MARKS
SEMESTER: II	CREDITS: 3	NO. OF HOURS PER WEEK: 3

1. C++ program to display prime numbers in a given range.
2. C++ program to find the sum of cubes of odd numbers up to n.
3. C++ program to find the sum of cubes of even numbers up to n.
4. C++ program to check whether the given number is Armstrong or not.
5. C++ program for finding factorial of a number using function.
6. C++ program for displaying Fibonacci series using function.
7. C++ program for implementation of class and object.
8. C++ program for implementation of function overloading.
9. C++ program for implementation of constructor
10. C++ program for implementation of destructor
11. C++ program for implementation of constructor overloading.
12. C++ program to add two numbers using operator overloading.
13. C++ program for implementation of single inheritance
14. C++ program for implementation of multiple inheritance
15. C++ program for implementation of multilevel inheritance

ELECTIVE- II: (B) DIFFERENCE EQUATIONS

COURSE CODE :	THEORY	100 MARKS
SEMESTER: II	CREDITS: 3	NO. OF HOURS PER WEEK: 3

Unit I **(9 hrs)**

Difference Calculus: The Difference Operator-Summation Generating - Functions and Approximate Summation.

Linear Difference Equations:First order equations - General results for linear equation – Solving linear equation.

Chapter-2: Sections 2.1 to 2.3

Chapter-3: Sections 3.1 to 3.3

Unit II **(9 hrs)**

Linear Difference Equations: Equations with variable coefficients - Nonlinear equations that can be linearized.

Chapter-3: Sections 3.5, 3.6

Unit III **(9 hrs)**

Linear Difference Equations : The z - transform - solving linear difference equation using z - transform.

Chapter-3: Sections 3.7

Unit IV **(9 hrs)**

The Self-Adjoint Second OrderLinear Equation: Second order linear equation - Sturmian Theory - Green's function.

Chapter-6: Sections 6.1 to 6.3

Unit V **(9 hrs)**

The Self-Adjoint Second Order Linear Equation : Disconjugacy - Riccati equation - Oscillation.

Chapter-6: Sections 6.4 to 6.6

PRESCRIBED TEXTBOOK:

W.G. Kelly and A.C. Petersan, Difference Equations: An introduction with Applications Acad. New York, 1991.

REFERENCE BOOKS:

1.S. Elayadi, An Introduction to Difference Equations, Springer New York 2005.

2. R.P. Agarwal Difference Equations and Inequalities, Marsel Dekker, New York, 2000.

EXTRA DISCIPLINARY COURSE- I
(A) NUMERICAL METHODS

COURSE CODE :	**PRACTICAL**	**100 MARKS**
SEMESTER: II	**CREDITS: 3**	**NO. OF HOURS PER WEEK: 3**

UNIT-I **(9hrs)**

Interpolation: - Central difference interpolation formulae (except Laplace Everett's formulae)

Chapter 7: Section 7.2

UNIT-II **(9hrs)**

Interpolation with unequal intervals: Lagrange's Interpolation formulae - Divided difference

Chapter 7: Sections 7.3 & 7.4

UNIT-III **(9hrs)**

Numerical solutions of Ordinary differential equations: Taylor's series Method - Picard's Method

Chapter 10: Sections 10.1 & 10.2

UNIT-IV **(9hrs)**

Numerical solutions of Ordinary differential equations: Euler's method - Modified Euler's Method

Chapter 10: Sections 10.3

UNIT-V **(9hrs)**

Numerical solutions of Ordinary differential equations : Runge-Kutta Method Milne's Method

Chapter 10: Sections 10.4&10.6

PRESCRIBED TEXTBOOK:

S. Arumugam, A. Thangapandi isaac, A. Somasundaram, Numerical Methods, SCITECH Publications (India) Pvt Ltd.2002.

REFERENCE BOOKS:

1. T. Veerarajan, T. Ramachandran, Numerical Methods, Tata McGraw-Hill Pvt Ltd.2006.
2. A. Singaravelu, Numerical Methods, MeenakshiAgency.2010.

EXTRA DISCIPLINARY COURSE- I
(B) QUANTITATIVE APTITUDE

COURSE CODE :	**PRACTICAL**	**100 MARKS**
SEMESTER: II	**CREDITS: 3**	**NO. OF HOURS PER WEEK: 3**

Unit 1 : **(9Hrs)**

Arithmetic : Number system-Percentage-Profit & Loss- Compound Interest-Average - Ratio - Proportion -Time and Work.

Unit 2 : **(9Hrs)**

Geometry : Basics of Geometry-Triangle-Polygons and Circle.

Unit 3 : **(9Hrs)**

Menstruation: Triangle-Parallelogram-Rectangle-Pathway in a Rectangle-Square- Rhombus-Trapezium-Circle and Semi-circle.

Unit 4 : **(9Hrs)**

Trigonometry : Trigonometric Ratio-Identities-Trigonometric values for common angles.

Unit 5 : **(9Hrs)**

Data Interpretation : Bar graphs-Pie Charts and Line graphs.

PRESCRIBED TEXTBOOK:

Quantitative Aptitude for Competitive Examinations by Dr.R.S.Agarwal S.Chand Publications.

REFERENCE BOOK:

1. Quantitative Abilities Arithmetic Ability by KiranPrakashan
2. Quicker Maths byM.Tyra,BSC Publishing Co. Pvt. Ltd.
3. Quantitative Aptitude for CAT by ArunSharma, McGraw Hill Education.

SEMESTER - III

CORE – IX: COMPLEX ANALYSIS

COURSE CODE :	THEORY	100 MARKS
SEMESTER: III	CREDITS: 4	NO. OF HOURS PER WEEK: 7

UNIT-I **(18hrs)**

Cauchy"s Integral Formula: The Index of a Point with Respect to A Closed Curve - The Integral Formula - Higher Derivatives.

Local Properties of Analytical Functions: Removable Singularities-Taylor's Theorem- Zeros And Poles-The Local Mapping - The Maximum Principle.

Chapter 4: Sections 2.1 to 2.3 and Sections 3.1 to 3.4

UNIT-II **(18hrs)**

The General Form of Cauchy's Theorem: Chains And Cycles-Simple Connectivity – Homology - The General Statement of Cauchy's Theorem - Proof of Cauchy's Theorem **The Calculus of Residues**– Residue Theorem - The Argument Principle .

Chapter 4: Sections 4.1 to 4.5 and Sections 5.1 & 5.2

UNIT-III **(18hrs)**

Harmonic Functions: Definition And Basic Properties of Harmonic Functions - Mean Value Property – Poisson's Formula-Schwarz's Theorem

The Riemann mapping Theorem: Statement and Proof

A Closure look at Harmonic function : Harnack"s principle.

Chapter 4 : Sections 6.1 to 6.4

Chapter 6: Sections 1.1 and Section 3.2

UNIT-IV **(18hrs)**

Power Series Expansions: Weierstrass's Theorem- Laurent series.

Partial Fractions and Factorization: Partial Fractions–Infinite Products-Canonical Products-The Gamma Function

The Riemann Zeta Function: The Product development:

Chapter 5: Sections 1.1 & 1.3, Sections 2.1 to 2.4 and Sections 4.1

UNIT-V **(18hrs)**

Doubly Periodic Functions : The Period Module- Unimodular Transformations – General Properties of Elliptic Functions.

The Weierstrass Theory : The Weierstrass -function – The Functions (s) and (s) – The Differential Equation – The Modular Function ()

Chapter 7 : Sections 2.1, 2.2 & 2.4 and Sections 3.1 to 3.4

PRESCRIBED TEXTBOOK:

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

REFERENCE BOOKS:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press,Oxford,2003.
2. J.B.Conway, Functions of one complex variable, Springer International Edition, 2003.
3. T.W.Gamelin, Complex Analysis, Springer International Edition, 2004.
4. D.Sarason, Notes on Complex function Theory, Hindustan Book Agency,1998

CORE – X: TOPOLOGY

COURSE CODE :	THEORY	100 MARKS
SEMESTER: III	CREDITS: 4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

Topological Spaces and Continuous Functions: Topological spaces, Basis for a topology, Product topology on X x Y, Subspace topology, Closed sets and Limit points, Continuous functions.

Chapter 2: Sections 12, 13 & 15 to 18.

UNIT-II **(18hrs)**

Connectedness and Compactness: Connected spaces, Connected subspaces of the real line, Components and Local connectedness, Compact spaces, Compact subspaces of the real line.

Chapter 3: Sections 23 to 27

UNIT-III **(18hrs)**

Countability and Separation Axioms Countability axioms, Separation axioms, Normal spaces Urysohn Lemma, Urysohn metrization theorem, Tietze extension theorem.

Chapter 4: Sections 30 to 35.

UNIT-IV **(18hrs)**

Topological Spaces and Continuous Functions Product topology: J-tuple of elements, Cartesian product, box topology, product topology, Tychonoff theorem. **Chapter 2:** Section 19. **Chapter 5:** Section 37.

UNIT-V **(18hrs)**

The Tychonoff Theorem: Homotopy of paths: homotopic, null homotopic, path homotopic, product of two paths, Fundamental group: loop, fundamental group, simply connected set, homomorphism induced by a map.

Chapter 9: Sections 51 & 52.

PRESCRIBED TEXTBOOK:

James R. Munkres ,Topology (Second edition) PHI, 2015.

REFERENCE BOOKS:

1. T. W. Gamelin and R.E. Greene, Introduction to Topology, The Saunders Series, 1983.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, Mcgraw-Hill
3. J. Dugundji, Topology, Prentice Hall ofIndia.
4. J. L. Kelly, General Topology,Springer.
5. S. Willard, General Topology,Addison-Wesley.

CORE- XI: MECHANICS

COURSE CODE:	THEORY	100 MARKS
SEMESTER: III	CREDITS: 4	NO. OF HOURS PER WEEK: 6

UNIT-I **(18 hrs)**

Introductory Concepts: The Mechanical system – Generalized coordinates – Constraints – Virtual work – Energy and Momentum.

Chapter 1: Sections 1.1 to 1.5

UNIT-II **(18 hrs)**

Lagrange's Equations: Derivation of Lagrange's equations – Examples –Integrals of motion.

Chapter 2: Sections 2.1 to 2.3

UNIT-III **(18 hrs)**

Hamilton's Equations : Hamilton's Principle –Hamilton's Equations – Other variational principles.

Chapter 4: Sections 4.1 to 4.3

UNIT – IV **(18 hrs)**

Hamilton-Jacobi Theory : Hamilton's Principle function – Hamilton-Jacobi Equation

Chapter 5: Sections 5.1 & 5.2

UNIT-V **(18 hrs)**

Canonical Transformation : Differential forms and generating functions – Special Transformations–Lagrange and Poisson brackets.

Chapter 6: Sections 6.1 to 6.3

PRESCRIBED TEXTBOOK:

Donald T.Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

REFERENCE BOOKS:

1.H. Goldstein, Classical Mechanics, (2nd Edition) NarosaPublishing House, New Delhi.

2.N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.

3.J.L.Synge and B.A.Griffth, Principles of Mechanics (3rdEdition) McGraw Hill Book Co., New York, 1970.

ELECTIVE – III
(A) STOCHASTIC PROCESSES

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: III	**CREDITS: 3**	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18hrs)**

Random Variables and Stochastic Processes: Introduction – Specification of stochastic processes

Markov Chains: Definitions and examples –Higher transition probabilities **Martingales:–** Introduction **–** Definitions and examples - Martingales convergence theorem

Stationary Processes and Time Series: Stationary processes.

Chapter 1: Section 1.5

Chapter 2: Sections 2.1 & 2.2

Chapter 3: Sections 5.1, 5.2 & 5. 3.2

Chapter 8: Sections 8.1

UNIT-II **(18hrs)**

Markov Chains: Classifications of states and chains – Determination of higher transition probabilities.

Chapter 2: Sections 2.4 & 2.5

UNIT-III **(18hrs)**

Markov Processes with Discrete State Space Poisson process and its extensions: Poisson process - Poisson process and Related distributions.

Chapter 3: Sections 3.1 & 3.2

UNIT– IV **(18hrs)**

Branching Processes: Introduction-Properties of generating functions of branching processes Probability of ultimate extinction– Distribution of the total number of progeny – Conditional limit laws.

Chapter 9 : Sections 9.1 to 9.5

UNIT-V **(18hrs)**

Applications in Stochastic Models: Queueing Systems and Models – Queueing Systems and Models – Notation-Steady State Distribution -Little's Formula - Birth and Death Processes in Queueing Theory:Markovian Models - Birth and Death Processes- The Model M/M/s- Model M/M/s/s: Erlang Loss Model.

Chapter 10 : Sections 10.1 & 10.2

PRESCRIBED TEXTBOOK:

Stochastic Processes by J. Medhi,3rd Edition, New Age International (P) Ltd.

REFERENCE BOOKS:

1. Cinlar.E., Introduction to Stochastic Processes, Englewood Cliffs, Prentice-Hall
2. Srinivasan S.K. and Mehata K.M., Stochastic Processes, 2nd Edition, Tata McGraw Hill, New Delhi,1988.
3. Taylor H.N. and Karlin S., An Introduction to Stochastic Modeling, Academic Press.

ELECTIVE - III
(B) ALGEBRAIC THEORY OF NUMBERS

COURSE CODE :	THEORY	100 MARKS
SEMESTER: III	CREDITS: 3	NO. OF HOURS PER WEEK: 6

UNIT-I **(18hrs)**

Algebraic Background : Rings and Fields – Factorization of Polynomials – Field extensions – Symmetric polynomials – Modules – Free Abelian groups.

Chapter 1 : Sections – 1.1 to 1.6

UNIT-II **(18hrs)**

Algebraic Numbers: Algebraic Numbers - Conjugate and Discriminants – Algebraic integers.

Chapter 2 : Sections – 2.1 to 2.3

UNIT-III **(18hrs)**

Algebraic Numbers: Integral bases – Norms and traces – Rings of integers

Chapter 2 : Sections – 2.4 to 2.6

UNIT-IV **(18hrs)**

Quadratic fields and Cyclotomic fields: Quadratic fields – Cyclotomic fields

Chapter 3 : Sections – 3.1 & 3.2

UNIT-V **(18hrs)**

Factorization into irreducible: Historical background: – trivial factorization – factorization into irreducibles

Chapter 4 : Sections – 4.1 to 4.3

PRESCRIBED TEXTBOOK:

1. I.Stewart and D.Tall. Algebraic number theory and Fermat's Last theorem (3rd edition) A.K Peters Ltd,Natrick, Mass. 2002

REFERENCE BOOKS:

1. Z. I. Borevic and I.R.Safarevic, Number theory, Academic Press, NY, 1966.
2. J.W.S.cassels and A.Frohlich, Algebraic , Number theory, Academic Press, New York, 1967.
3. P. Ribenboim, Algebraic numbers, Wiley, New York, 1972.
4. P.Samuel, Algebraic Theory of Numbers, Houghton Mifflin company, Boston, 1970

EXTRA DISCIPLINARY COURSE- II
(A) STATISTICAL METHODS

COURSE CODE:	**THEORY**	**100 MARKS**
SEMESTER: III	**CREDITS: 3**	**No. OF HOURS PER WEEK: 3**

UNIT-I **(9hrs)**

Correlation – Methods of correlation – Karl-Pearson's coefficient of correlation- Spearman's rank correlations (except correlation of grouped data and concurrent deviation)

Chapter 7 of Book [1]

UNIT-II **(9hrs)**

Regression equations-Deviation taken from arithmetic mean of X and Y-Deviation taken from assumed mean.

Chapter 8 of Book [1]

UNIT-III **(9hrs)**

Chi square test-test of independence-test of goodness of fit- test of homogeneity

Chapter 13 of Book [1]

UNIT-IV **(9hrs)**

Analysis of variance-one-way classifications

Chapter 14 of Book [1]

UNIT-V **(9hrs)**

Markov analysis-State transition matrix- Transition diagram-construction of state transition matrix- Markov analysis algorithm.

Chapter 15 of Book [2]

PRESCRIBED TEXTBOOK:

1. Elementary Statistical Methods, Dr.S.P.Gupta, Sultanchand & Sons, New Delhi, Eighteen Edition,2009
2. Operations Research, Kanti Swarup, P.K.Gupta, Man Mohan Sultanchand & Sons,New Delhi,Twelth Edition,2004

REFERENCE BOOK:

1.Fundamentals of Statistics, S.C.Gupta, Himalaya publishing house, Sixth edition, 2004.

EXTRA DISCIPLINARY COURSE- II
(B) LOGICAL REASONING FOR COMPETITIVE EXAMINATIONS

COURSE CODE:	**THEORY**	**100 MARKS**
SEMESTER: III	**CREDITS: 3**	**No. OF HOURS PER WEEK: 3**

Unit 1 : Alphanumeric Series, Reasoning Analogies, Blood Relations

Unit 2 : Calendars, Clocks, Coding- Decoding.

Unit 3 : Data Sufficiency, Decision Making , Dices.

Unit 4: Directions, Order & Ranking, Seating Arrangements

Unit 5 :Statement & Assumptions, Statement & Conclusions ,Syllogism

PRESCRIBED TEXTBOOK:

1. A modern approach to Logical Reasoning by Dr.R.S.Agarwal .S.Chand Publications

REFERENCE BOOK:

1. A Comprehensive Book of Logical Reasoning, IBS Institute Chandigarh
2. Arihant ,Analytical & Logical Reasoning by Peeyush Bharadwaj, Arihant Publications
3. How to prepare for Logical Reasoning for CAT & other Management Examinations by Arun Sharma.,Mc. Graw Hill Publishers.

SEMESTER - IV

CORE – XII: CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

COURSE CODE :	THEORY	100 MARKS
SEMESTER: IV	CREDITS: 4	NO. OF HOURS PER WEEK: 6

Unit I **(18hrs)**

Variational Problems with Fixed Boundaries: The Concept of Variation and Its properties - Euler's equation – Variational Problems for Functionals of the Form $\int_a^b F(x, y, y')dx$ - Functionals Dependent on Higher-Order Derivatives – Functionals Dependent on Functions of Several Independent Variables – Variational Problems in Parametric Form.

Chapter-1: Sec 1.1 to 1.6 of Book [1]

Unit II **(18 hrs)**

Variational Problems with Moving Boundaries:

Functional of the Form $I[y(x)] = \int_{x1}^{x2} F(x, y, y')dx$ – Variational Problem with a Movable Boundary for a Functional Dependent on Two Functions - One sided variations – Reflection and Refraction of Extremals – Diffraction of Light Rays.

Chapter-2: Sec 2.1 to 2.5 of Book [1]

Unit III **(18 hrs)**

Preliminary Concepts: Introduction – Abel's Problem – Integral equation, Definition – Linear and non-linear integral equations – Fredholm integral equation of the first kind, the second kind & the third kind – Homogeneous Fredholm integral equation - Volterra integral equation of the first kind , the third kind & the second kind - Homogeneous Volterra integral equation – Singular integral equation– Special kinds of kernels – Symmetric kernel – Separable or degenerate kernel
– Integral equation of the convolution type – Iterated kernels of functions – Resolvent kernel or reciprocal kernel – Eigenvalues – Eigenfunctions-Leibnitz rule of differentiation under integral sign- An important formula for converting a multiple integral into a single ordinary integral- Regularity conditions- Square-integrable functions or $\mathscr{L}_2$- function- The inner or scalar product of two functions- Solution of an integral equation. Definition- Solved example.

Chapter-1: Sec 1.1 to 1.18 of Book [2]

Unit IV **(18hrs)**

Conversion of Ordinary Differential Equations into Integral Equations: Introduction – Initial Value Problems – Methods of Converting an Initial Value Problem into a Volterra Integral Equation – Boundary Value Problem – Methods of Converting a Boundary Value Problem into a Fredholm Integral Equation.

Chapter2: Sec 2.1 to 2.6 of Book [2]

Unit V **(18 hrs)**

Homogeneous Fredholm Integral Equations: Characteristic Values – Characteristic Functions – Solution of Homogeneous Fredholm Integral Equations of the Second Kind with Separable Kernel– Solved examples.

Chapter-3: Sec 3.1 to 3.3 of Book [2]

PRESCRIBED BOOKS:

1.S. Gupta, Calculus of Variations with Applications, Prentice- Hall of India, New Delhi, 1997.

2.M. D. Raisinghania, Integral Equations and Boundary Value Problems , S.Chand Publication

REFERENCE BOOKS:

1. Gupta. S, Calculus of Variations with Applications, Prentice- Hall of India, NewDelhi, 2005.
2. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques. Academic Press, New York,2012.
3. Sudir K. Pundir and Rimple Pundir, Integral Equations and Boundary Value Problems Pragati Prakasam, Meerut,2005.
4. AnadiSankar Gupta, Calculus of variations, PHI Learning private Ltd

CORE – XIII: DIFFERENTIAL GEOMETRY

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: IV	**CREDITS:** 4	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18hrs)**

Curves in the plane and in space : Curves -Arc length – Reparametrization-Closed Curves-Level curves versus parametrization curves

How much does a Curve Curve: Curvature -Plane curves - Space curves.

Chapters: 1 & 2

UNIT-II **(18hrs)**

Surfaces in three dimensions : Surface –Smooth surfaces-Smooth maps- Tangents and derivatives Normals and Orientability

Examples of surfaces: Level surfaces-Quadric surfaces-Compact surfaces

Chapter 4: 4.1 to 4.5

Chapter 5: 5.1, 5.2 & 5.4

UNIT-III **(18hrs)**

Curvature of surfaces: The second fundamental form- Curvature of curves on a surface-Normal and principal Curvature-

Gaussian Curvature and the Gauss Map: Gaussian and mean curvatures -Gaussian curvatures of compact surface --Gauss map.

Chapter 6: Sections 6.1, 6.2 & 6.3

Chapter 7: Section**s** 7.1, 7.5 & 7.6

UNIT-IV **(18hrs)**

Geodesics :Definition and Basic Properties -Geodesic equations-Geodesics as shortest paths-Geodesic coordinates.

Chapter 8: Sections 8.1, 8.2, 8.4 & 8.5

UNIT-V **(18hrs)**

Gauss's Theorema Egregium: Gauss's Remarkable Theorem-Isometries of surfaces- Codazzi-Mainardi Equations- Compact surfaces of constant Gaussian curvature.

Chapter 10 : Sections 10.1 to 10.4

PRESCRIBED TEXTBOOK:

Andrew Pressley, Elementary Differential Geometry, Springer- Indian Edition, 2004.

REFERENCE BOOKS:

1. J.A. Thorpe, Elementary Topics in Differential Geometry, Springer-Indian edition.
2. E.D. Bloch, A First Course in Geometric Topology and Differential Geometry, Birkhauser,1997.
3. M.P. doCarmo, Differential Geometry of Curves and Surfaces, Prentice-Hall,1976.

CORE – XIV: FUNCTIONAL ANALYSIS

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: IV	**CREDITS: 4**	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18hrs)**

Fundamentals of Normed Spaces: Normed Spaces – Riesz lemma –Continuity of Linear Maps.
Chapter :II Sections 5.1 to 5.7, 6.1 to 6.5

UNIT-II **(18hrs)**

Fundamentals of Normed Spaces: Bounded Linear Maps – Hahn Banach Theorems – Hahn-Banach separation theorem – Hahn- Banachextension theorems,Unique Hahn Banach Extensions – Banach Spaces.
Chapter :II Sections 6.6 to 6.8, 7.1 to 7.11, 8.1 to 8.4

UNIT-III **(18hrs)**

Bounded Linear Maps on Banach Spaces: Uniform Boundedness Principle – Resonance theorem – Closed Graph Theorem– Open mapping Theorem – Bounded Inverse Theorem – Two-norm theorem.
Chapter :III Sections 9.1 to 9.3, 10.1 to 10.7, 11.1 to 11.3

UNIT-IV **(18hrs)**

Bounded Linear Maps on Banach Spaces: Spectrum of Bounded Operator
Spaces of Bounded Linear Functional: Weak and Weak* Convergence – Bolzano-Weierstrass Property –Reflexivity.
Chapter :III Sections 12.1 to 12.5
Chapter-IV: Sections 15.1 to 15.4, 16.1 to 16.4

UNIT-V **(18hrs)**

Inner Product Spaces: Inner Product Spaces – Orthonormal Sets – Bessel's Inequality –
Bounded Operators on Hilbert Spaces: Bounded Operators – Normal, Unitary and Self - Adjoint Operators.
Chapter: VI Sections 21.1 to 21.3, 22.1 to 22.2, 22.4 to 22.7,
Chapter-VII: Sections 25.2, 26.1 to 26.3

PRESCRIBED TEXTBOOK:

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

REFERENCE BOOKS:

1. W. Rudin Functional Analysis, Tata McGraw-Hill PublishingCompany, New Delhi , 1973
2. G.Bachman&L.Narici, Functional Analysis Academic Press, New York,1966.
3. Goffman and G.Pedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi,1987
4. Kreyszig, Introductory Functional Analysis with Applications, John wiley& Sons, New York., 1978.
5. M.Thamban Nair, Functional Analysis. A First Course,Prentice Hall of India, New Delhi,2002

ELECTIVE– IV
(A) GRAPH THEORY

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: IV	**CREDITS: 4**	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18hrs)**

Graphs and Subgraphs: Graphs and Simple Graphs-Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection– Cycles. **Trees:** Trees

Chapter 1: Sections 1.1 to 1.7

Chapter 2: Section 2.1

UNIT-II **(18hrs)**

Trees: Cut Edges and Bonds – Cut Vertices

Connectivity: Connectivity C Blocks.

Chapter 2: Sections 2.2 & 2.3

Chapter 3: Section 3.1 & 3.2

UNIT-III **(18hrs)**

Euler Tours and Hamilton Cycles: Euler Tours - Hamilton Cycles

Edge Colourings: Edge Chromatic Number

Chapter 4: Sections 4.1 & 4.2

Chapter 6 : Section 6.1

UNIT-IV **(18hrs)**

Independents Sets and Cliques: Independent sets – Ramsey"s Theorem.

Vertex Colourings: Chromatic Number – Brooks" Theorem .

Chapter 7: Section 7.1 & 7.2

Chapter 8: Section 8.1 & 8.2

UNIT-V **(18hrs)**

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 to 9.3 & 9.6)

PRESCRIBED TEXTBOOK:

J. A. Bondy and U.S.R. Murty , Graph Theory with Applications, Macmillan, London, 1976.

REFERENCE BOOKS:

1.J. Clark and D. A. Holton A First look at Graph Theory, Allied Publishers, New Delhi
1995.

2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park,1989.
3. R. J. Wilson and J. J. Watkins, Graphs, An Introductory Approach, John Wileyand Sons, New York,1989.
4. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition,2004, IndianPrint.
5. S. A. Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987

ELECTIVE – IV
(B) MATHEMATICAL STATISTICS

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: IV	**CREDITS: 4**	**NO. OF HOURS PER WEEK: 6**

UNIT-I **(18hrs)**

Sample Moments and their Functions: The notion of a sample-The notion of a statistic-The distribution of the arithmetic mean of the independent normally distributed random variables-The χ^2 distribution- The distribution of the statistic $(\bar{X} - S)$.

Chapter 9 : Sections 9.1 to 9.5

UNIT-II **(18hrs)**

Sample Moments and their Functions: Student's t-distribution – Fisher's Z-distribution – The distribution of $\bar{X}$ for some non normal populations-The distribution of sample moments and sample correlation coefficients of a two-dimensional normal population-The distribution of regression coefficients

Chapter 9 : Sections 9.6 to 9.10

UNIT-III **(18hrs)**

Significance Tests: The concept of a statistical test-Parametric tests for small samples-Parametric tests for large samples- The χ^2 test-Tests of the Kolmogorov and Smirnov type The Wald- Wolfovitz and Wilcoxon-Mann-Whitney tests-Independence tests by contingency tables.

Chapter 12: Sections 12.1 to 12.7

UNIT-IV **(18hrs)**

The Theory Of Estimation: Preliminary notions-Consistent estimates-Unbiased estimates-The sufficiency of an estimate-The efficiency of an estimate- Asymptotically most efficient estimates-Methods of finding estimates-Confidence intervals.

Chapter 13: Sections 13.1 to 13.8.

UNIT-V **(18hrs)**

Theory of Hypotheses Testing: The power function and the OC function-Most powerful tests-Uniformly most powerful test-Unbiased tests

Chapter 16: Sections 16.2 to 16.5

PRESCRIBED TEXTBOOK:

1. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and sons, NewYork, 1963.

REFERENCE BOOKS:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
3. Y.S.Chow and H.Teicher, Probability Theory, Springer Verlag. Berlin, 1988 (2nd Edition)
4. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
5. V.K.Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.
7. B.R.Bhat ,Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999
8. J.P. Romano and A.F. Siegel, Counter Examples in Probability and Statistics, Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968

ELECTIVE – V
(A) FUZZY SETS AND THEIR APPLICATIONS

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: IV	**CREDITS: 3**	**NO. OF HOURS PER WEEK: 5**

UNIT-I **(15hrs)**

Fundamental Notions: Review of the notion of membership, The concept of a fuzzy subset, Dominance relations, Simple operations on fuzzy subsets, Set of fuzzy subsets for E and M finite, Properties of the set of fuzzy subsets, Product and algebraic sum of two fuzzy subsets. **Chapter 1:** Sections 1 to 8

UNIT-II **(15hrs)**

Fuzzy Graphs: Fuzzy relations, composition of Fuzzy relations, Fuzzy subsets induced by a mapping, conditioned Fuzzy subsets, Properties of Fuzzy binary relations, Transitive closure of a Fuzzy binary relations, Paths in a finite Fuzzy graphs.

Chapter 2: Sections 10 to 18

UNIT-III **(15hrs)**

Fuzzy Relations: Fuzzy preorder relations, Similitude relations, Similitude sub relations in a fuzzy preorder, Antisymmetry, Fuzzy order relations, Antisymmetric relations without loops. Ordinal relations. Ordinal functions in a fuzzy order relation, Dissimilitude relations, Resemblance relations, Various properties of similitude and resemblance, Various properties of fuzzy perfect order relations.

Chapter 2: Sections 19 to 29

UNIT-IV **(15hrs)**

Fuzzy Logic: Characteristic function of a fuzzy subset. Fuzzy variables, Polynomial forms, Analysis of a function of fuzzy variables. Method of Marinos, Logical structure of a function of fuzzy variables, Composition of intervals, Fuzzy propositions and their functional representations, The theory of fuzzy subsets and the theory of probability.

Chapter 3: Sections 31 to 36 , 39 & 40

UNIT-V **(15hrs)**

The Laws of Fuzzy Composition: Review of the notion of a law of composition, Laws of fuzzy internal composition. Fuzzy groupoids, Principal properties of fuzzy groupoids, Fuzzy monoids, Fuzzy external composition, Operations on fuzzy numbers.

Chapter 4: Sections 43 to 49

PRESCRIBED TEXTBOOK:

A. Kaufman, Introduction to the theory of Fuzzy subsets, Vol. I, Academic Press, New York, 1975.

REFERENCE BOOKS:

1. H. J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai,1996
2. George J. Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic-Theory and Applications, Prentice Hall India, New Delhi,2001.
3. L.A. Zadeh, Fuzzy Set Theory and its Applications, 4^{th} edition.

ELECTIVE – V
(B) ALGEBRAIC TOPOLOGY

COURSE CODE :	**THEORY**	**100 MARKS**
SEMESTER: IV	**CREDITS: 4**	**NO. OF HOURS PER WEEK: 5**

UNIT-I **(15hrs)**

The Fundamental Group :Homotopy of paths **-** The Fundamental Group – Covering spaces **-** The Fundamental Group of the circle – Retractions and Fixed points.

Chapter 9: Sections 51 to 55.

UNIT-II **(15hrs)**

The Fundamental Group :The Fundamental Theorem of Algebra – The Borsuk–Ulam Theorem – Deformation Retracts and Homotopy Type – The Fundamental Group of S^n **-** Fundamental Groups of some surfaces.

Chapter 9 : Sections 56 **to** 60

UNIT-III **(15hrs)**

The Seifert-van Kampen Theorem : Direct sums of Abelian Groups – Free products of Groups – Free Groups – The Seifert–van Kampen Theorem – The Fundamental Group of a wedge of circles.

Chapter 11 : Sections 67 to 71.

UNIT-IV **(15hrs)**

Classification of Surfaces : Fundamental groups of surfaces – Homology of surfaces – Cutting and pasting – The classification theorem – Constructing compact surfaces.

Chapter 12 : Sections 74 to 78

UNIT-V **(15hrs)**

Classification of Covering Spaces : Equivalence of covering spaces – The Universal covering space – Covering transformations – Existence of covering spaces

Chapter 13 : Sections 79 to 82

PRESCRIBED TEXTBOOK:

1. J.R.Munkres,Toplogy, Pearson Education Asia , Second Edition 2002

REFERENCE BOOKS:

1. M.K.Agoston, Algebraic topology – A First Course, Marcel Dekker, 1962.
2. Satya Deo, Algebraic Topology , Hindustan Book Agency, New Delhi, 2003.
3. M.Greenberg and Harper, Algebraic Topology – A First course, Benjamin/Cummings, 1981.
4. C.F. Maunder, Algebraic topology, Van Nostrand, New York, 1970.
5. A.Hatcher, Algebraic Topology, CambridgeUniversity Press, South Asian Edition 2002.
6. W.S.Massey, Algebrai Topology : An Introduction, Springer 1990