Bharathidasan Government College for Women (Autonomous)

(Affiliated to Pondicherry University)

B.Sc. Mathematics (Honors)

B.Sc. Mathematics (Honors with Research)

REGULATIONS, CURRICULUM & SYLLABUS

(Under the National Education Policy - NEP 2020)

Effective from the Academic Year 2023 - 2024

4th October 2024

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BHARATHIDASAN GOVT. COLLEGE FOR WOMEN

(AN AUTONOMOUS COLLEGE AFFILIATED TO PONDICHERRY UNIVERSITY)

Department of Mathematics

UG Degree (B.Sc. Honors or B.Sc. Honors with Research) in Mathematics

NATIONAL EDUCATION POLICY (NEP 2020) REGULATIONS- 2023

1. INTRODUCTION:

The NEP curriculum is implemented from the Academic Year 2023-24.

1.1. Major Highlights

The Department of Mathematics launch UG (Honors/Honors with Research) with lateral entry–exit facility in all the years of study.

1.2. Age Limit:

As per UGC Norms.

2. SHORT-TITLES AND DEFINITIONS

2.1 Definitions

Terms used in the NEP-CBCS Regulations shall have the meaning assigned to them as given below unless the context otherwise requires:

a. **Credit:** A credit is the number of hours of instruction required per week for the given subject in a given semester of 16-18 weeks. One credit is equivalent to 15 hours of teaching (lecture or tutorial) or 30 hours of practice or field work or community engagement and service per Semester.

b. **"Academic Year"** means the year starting on 1st day of July and ends on the 30th day of June succeeding year.

c. "**Residence time**" means the time a student spends for attending classes in the College/Institution (either Online/Offline) as a full-time student and enrolled in any Academic programme of the Institution.

d. **"Semester"** means 18 weeks (90 Working days) of teaching-learning session of which two weeks shall be set apart for examinations and evaluation.

e. **"Grade"** means a letter grade assigned to a student in a Course for her performance at academic sessions as denoted in symbols of: O(outstanding), A+(Excellent), A (Very good), B+ (good), B (Above average), C (average), P (Pass) F (fail) and Ab (Absent) with a numeric value of O = 10, A+ = 9, A = 8, B+ = 7, B = 6, C = 5, P = 4, F = 0 and Ab = 0.

f. **"Grade Point Average (GPA)"** means an average of the Grades secured by a student in all courses in a given academic session duly weighted by the number of credits associated to each of the courses.

g. **"Cumulative GPA (CGPA)"** is the weighted average of all courses the student has taken in a given Programme.

h. **"A common Course"** means the set of courses that all students who are admitted to any Programme of the University/College are required to study; these courses include Languages (English- modern Indian languages), NEP specific courses- viz. Understanding India, Environmental sciences/Education, Health and wellbeing/Yoga, Digital & Technological solutions;

i. "**Major Discipline**" means the core subject mandatory for the programme, Major discipline may be a single discipline or interdisciplinary/multidisciplinary courses. Eg. B.Sc. (Maths) or B.Sc. (Maths and Chemistry).

j. **"Minor Discipline"** means an allied or elective subject to major discipline.

    i. **"Minor discipline Cognate"** refers to a pool of courses offered by the parent department/cognate (allied) departments.

    ii. **"Minor discipline Generic"** refers to the subsidiary/elective subjects chosen from a basket of courses offered by different departments other than the minors offered by the parent department.

k. **"Credit Requirement"** for a Degree/Diploma/Certificate Programme means the minimum number of credits that a student shall accumulate to achieve the status of being qualified to receive the said Degree, Diploma/Certificate as the case may be;

l. **"Exit option"** means the option exercised by the students, to leave the Programme at the end of any given Academic year; "Lateral entry" means a student being admitted into an ongoing Programme of the University other than in the 1st year of the programme.

m. **"Vocational Studies/Education"** This refer to set of activities for participation in an approved project or practical or lab, practices of application of scientific theories, studio activities involving students in creative artistic activities, workshop-based activities, field-based shop-floor learning, and Community engagement services, etc.

n. **Skill-based learning/project -** This refers to activities designed to understand the different socio-economic contexts, first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process.

o. **Work-based internship -** This refers to structured internships with local industry, businesses, artists, crafts persons etc. which will further improve employability.

3. Duration, Eligibility and Award of UG Certificate, UG Diploma, UG Degrees

3.1 Duration of the Programme:

The duration of the UG programme is 4 years or 8 semesters. Students who desire to undergo a Three-year UG Programme will be allowed to exit after completion of the 3rd year. If a student wants to leave after the completion of the first or second year, the student will be given a UG Certificate or UG Diploma, respectively, provided they secure the prescribed number of credits.

Students who exit with a UG certificate or UG diploma are permitted to re-enter within three years and complete the degree programme. Students may be permitted to take a break from the study, they are allowed to re- enter the degree programme within 3 years and complete the programme within the stipulated maximum period of seven years.

3.2 Eligibility:

All students who have completed their Higher Secondary School Certificate are eligible for admission into an undergraduate degree programme, subject to pass in +2 with Mathematics or equivalent stage of education to Level-4 (Levels in NHEQF) with a minimum of 50% of total marks.

3.3 Awarding of UG Certificate, UG Diploma and Degrees:

UG Certificate:

Students who opt to exit after completion of the first year and have earned a minimum of 40 credits will be awarded a UG certificate if, in addition, they complete work based vocational course/internship of 4 credits during the summer vacation of the first year.

UG Diploma:

Students who opt to exit after completion of the second year and have earned a minimum of 80 credits will be awarded the UG diploma if, in addition, they complete wok based vocational course/internship of 4 credits during the summer vacation of the second year.

Three - year UG Degree:

Students who wish to discontinue after the 3-year UG will be awarded a UG Degree in the Major discipline after successful completion of three years, earning a minimum of 120 credits and satisfying the minimum credit requirements as mentioned in the table below.

Four - year UG Degree (Honors):

A four-year UG Honors degree in the major discipline will be awarded to those who complete a four-year degree, earning a minimum of 160 credits and have satisfied the credit requirements as mentioned in the table of Breakup of credits and courses.

Four - year UG Degree (Honors with Research):

Students who secure minimum of 7.5 CGPA in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure a minimum of 160 credits, including 12 credits from a research project, will be awarded UG Degree (Honors with Research).

4. STRUCTURE OF THE UNDERGRADUATE PROGRAMME

The Curriculum Framework designed by UGC for implementing NEP 2020 specifies that all Undergraduate (UG) degree programmes are to be from a period of either for 3 years or for 4 years leading to award of UG or UG (Hons) Degrees.

4.1 Structure of the Programme

Semester	**Major Discipline**	**Minor Discipline**	**Multi disciplinary courses**	**Skill Enhancement Courses**	**Ability Enhancement Courses**	**Value Added Courses**	**Total Credits**
I	Major 1 (4 credits) 100 Level	Minor 1 (4 credits) 100 Level	MD - 1 (3 credits)	SEC – 1 (3 credits)	AECC – 1 (2 credits)	VAC – 1 (2 credits) & VAC – 2 (2 credits)	20
II	Major 2 (4 credits) 100 Level	Minor 2 (4 credits) 100 Level	MD - 2 (3 credits)	SEC – 2 (3 credits)	AECC – 2 (2 credits)	VAC – 3 (2 credits) & VAC – 4 (2 credits)	20
Students exiting the programme after securing 40 credits will be awarded UG Certificate in Mathematics provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.							

Semester	Major Discipline	Minor Discipline	Multi disciplinary courses	Skill Enhancement Courses	Ability Enhancement Courses		Total Credits
III	Major 3 (4 credits) & Major 4 (4 credits) 200 Level	Minor 1 (4 credits) 200 Level and above	MD - 3 (3 credits)	SEC – 3 (3 credits)	AECC – 3 (2 credits)		20
IV	Major 5 - 7 (12 credits) 200 Level	Minor 1 (4 credits) 200 Level and above			AECC – 3 (2 credits)	Community Engagement and Services (2 credits)	20
Students exiting the programme after securing 80 credits will be awarded UG Diploma in Mathematics, provided they secure additional 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship. Summer Internship could be initiated during holidays and continued to the Vth semester.							

Semester	Major Discipline	Minor Discipline		Total Credits
V	Major 9 - 11 (12 credits) 300 Level	Minor 1 (4 credits) 200 Level and above	Summer Internship (4 credits) Major 8	20
VI	Major 12 - 15 (16 credits) 300 Level	Minor 1 (4 credits) 200 Level And above		20
Students who want to undertake 3-year UG programme will be awarded UG Degree in Mathematics upon securing 120 credits. Also, a minimum of 12 credits will be allotted to the minor stream relating to vocational education and training spreading through 2, 3, 4 &5 semesters. Internship is included as the Major 11.				

Semester	Major Discipline	Minor Discipline		Total Credits
VII	Major 16 - 18 (16 credits) 400 Level	Minor 1 (4 credits) 300 Level and above		20
VIII	Major 19 & 20 (8 credits) 400 Level		Research Project / Dissertation OR Three 3 credit Major discipline courses chosen from the list of courses (12 Credits)	20
Students will be awarded UG Degree (Honors with Research) in Mathematics provided they secure 160 credits. Honors students not undertaking research will do 3 courses for 12 credits in lieu of a research project / Dissertation. Students of UG honors with research will choose a research component in the 4^{th} year.				

4.2 BREAKUP OF CREDITS AND COURSES

Table of Breakup of Credits and Courses

S. No.	Component	3 Year Degree	4 Year Hons Degree
1	Major Disciplinary	60 Credits (15 Courses of 4 credits each)	80 Credits (20 Courses of 4credits each)
2	Minor Discipline	24 Credits (6 Courses of 4 Credits each)	32 Credits (8 Courses of 4 credits each)
3	Multi-Disciplinary Courses	9 Credits (3 courses of 3credits each)	9 Credits (3 courses of 3 credits each)
4	Ability Enhancement Courses	8 Credits (4 courses of 2 credits each)	8 Credits (4 courses of 2 credits each)
5	Skill Enhancement Course	9 Credits (3 courses of 3 credits each)	9 Credits(3 courses of 3 credits each)
6	Common Value added Course	8 Credits (4 courses of 2 credits each)	8 Credits(4 courses of 2 credits each)
7	Community Science	2 Credits (1field based course)	2Credits (1field based course)
8	Research Dissertation Project	-	12 Credits(Project report & background subjects)
9	Total credits required	120 Credits	160 Credits

Note: Honors students not undertaking research will do 3 courses for 12 credits in lieu of a project.

4.3 NEP Classification of Courses:

i) Major Disciplinary courses (MJD): (60/80 credits)

Major disciplinary courses are subject specific compulsory subjects that a student has to complete to obtain the UG/UG (Hons) Degree in the given discipline. Major disciplinary courses shall constitute 50% of the total credits.

All discipline specific major courses shall be designed for 4 credits each with one/two additional hours or guidance of teaching at Tutorials/Practicals.

UG programmes may be offered in a single major discipline or in Multiple Major disciplines giving equal weightage in credits. For example, a B.Sc. course may be in a single discipline like B.Sc. (Mathematics) or with multiple major disciplines like B.Sc. (Mathematics, Physics & Chemistry).

ii) Minor Disciplinary Course (MID): (24/32 credits)

Minor disciplinary courses refer to those subjects which are Allied/Specialisation/Elective subjects to the Major discipline. These allied courses are expected to provide additional understanding of the subject in a specific focused area. For example, a B.A. (Political Science) student shall study allied subjects like Public Administration, Sociology as these subjects have inter linkages with the Major Disciplinary subjects. Minor disciplinary courses (MID) may also be designed by the parent department or collaborated with sister departments. Parent departments may introduce minor specialisations to students by offering a set of 6 to 8 courses in one/two streams as electives or specialization subjects. In order to provide choice to the students to choose a particular specialisation/elective, the BOS may develop 2 to 3 streams of minor specialisation courses to focus on such trades for better placement of students. Each stream of 6/8 specialisation/elective subjects may facilitate award of two/three unique degrees in a given major.

iii) Multi-Disciplinary Courses (MLD): (9 Credits)

All undergraduate students are mandated to pursue 9 credits worth of courses in such Multi-disciplinary areas/Courses out of 9/10 NEP defined subjects. Colleges may identify any 3 multiple disciplinary streams listed below based on availability of resources and manpower (from Natural Sciences, Physical Sciences, Mathematics & Statistics, Computer Science/Applications, Data Analysis, Social Sciences, Humanities, Commerce & Management, Library Science, Media Sciences, etc.). Students are expected to learn basic/introductory courses designed by other departments for this purpose. Colleges may list any 3 introductory courses (one each in natural Sciences, Physical Sciences and Humanities) for uniform adoption of all UG students.

iv) Ability Enhancement (AEC) Courses: (8 Credits)

All Undergraduate (UG) students are mandated to complete at least 8 Credits worth of Courses which focus on Communication and Linguistic skills, Critical reading, and writing skills. These courses are expected to enhance the ability in articulation and presentation of their thoughts at workplace. Colleges may design these ability enhancement courses tuned to the requirements of given major discipline. E.g. A course in Business Communication is more appropriate in place of literature/prose/poetry.

Ability Enhancement Course	
I. English Language	II. Indian Language (two courses)
a) English Language & Literature – 1 and 2 b) Functional English – 1 and 2 c) Communicative English – 1and 2	a) Indian language & Literature – 1 and 2 b) Functional language – 2 c) Communicative language – 1 and 2

v) Skill Enhancement Course: (9 Credits)

These courses focus at imparting practical skills with hands-on Training. In order to enhance the employability of students, Colleges are expected to design such courses that they deem fit for their students for better employment/entrepreneurship/career development, etc. Colleges may also outsource the Skill Enhancement Courses to AICTE approved agencies for conducting short term Training Workshops, Skill India initiatives of GOI and approved Trades by Skill development of corporation are to be considered short term courses.

vi) Value Added Common Courses (VAC): (8 credits)

Under NEP, the UGC has proposed for 6 to 8 credits worth of common courses which are likely to add value to overall knowledge base of the students. These courses include: Understanding India, Environmental Sciences/Education, Digital technologies and Health, Wellness, Yoga Education, Sports & Fitness. The course structure and coverage of topics are suggested by UGC in its draft documents, colleges/UG Boards of Studies may design the methodology for conducting these value added courses.

vii) Summer Internship (2 to 4 Credits)

As per the UGC guidelines all UG students should be exposed to 4 to 6 week Summer Internship in any of the industrial organizations/Training Centre's/Research Institution, etc. Such Summer Internship is to be conducted in between 4th Semester and 5th semester. A review of report and award of grade based on Work based learning by students is to be recorded during the 5th Semester.

viii) Community Engagement and Service (CES) (2 credits)

All UG students are also mandated to participate in a 15 days community engagement activity during their winter vacation between 3rd and 4th Semesters. This Community engagement activity is expected to expose the students to social problems of neighborhood village. Students may prepare a report on the activities carried out for an award of 2 credits.

ix) Research Project (12 Credits)

All UG (Hons) Degree students are expected to conduct a semester long Research work during their 8th Semester and submit a Research Report. Students may be given necessary guidance by faculty members in identifying the research problem, conduct of study and preparation of a Project Report. All these Research Reports are evaluated by a Jury of external experts. A presentation of Results and Viva may also be part of evaluation. A Publication out of findings of the Research Project may also be encouraged.

x) Audit courses: 0 Credits

Audit courses offered do not carry any credits. Evaluation will be based on continuous assessment. Students may be given a pass or fail (P/F) based on the assessment that may consist of class tests, homework assignments, and/or any other innovative assessment methodology suitable to the expected learning outcome, as determined by the faculty in charge of the course of study.

4.4 Levels of Courses:

The levels are:

0 to 99 = Pre-requisite/ Bridge courses

100 to 199 = Foundation courses/Introductory courses

200 to 299 = Intermediate Level courses

300 to 399 = Core courses/Advanced courses

400 and above = Specialization subjects

4.5 Pedagogical Styles

In order to achieve the expected Learning outcomes, UGC Framework has specified different Pedagogical approaches for different courses at undergraduate level. These approaches include:

a) Lecture course

b) Tutorial course

c) Practice cum or laboratory courses

d) Seminar Course

e) Internship course

f) Studio activity-based course

g) Field practicing

h) Project work courses

i) Community engagement and service course

The details of these different types of Pedagogical methods are as follows:

Table: Pedagogical Approaches

COURSE TYPES	APPROACH
Lecture Courses	Regular classroom lectures by qualified / experienced Expert Teachers • These Lectures may also include classroom discussion, demonstrations, case analysis • Use of Models, Audio-Visual contents, Documentaries, PPTs may supplement
Tutorial Courses	Problem solving Exercise classes, guided discussion, supplementary readings, vocational training, etc.
Practical / Lab work	Practical Lab activity with Theoretical support Mini projects, Activity based engagement, Program executions, Data processing and presentation exercise.
Seminar Course	A course requiring student to design and participate in discussions, Group Discussions, Elocution and Debate, Oral Communication Paper presentations, Poster Presentation, Role play participation, Quiz competitions, Business plan preparation/presentation, etc.
Internship course	Courses requiring students to *Learn by Doing* in the workplace external to the educational Institutions. Internships involve working in Software Companies, Research and Higher Educational Institution Laboratories, Corporate Offices, etc. All Internships should be properly guided and inducted for focused learning.
Research Project	Students need to study and analyze the recent research publications from indexed/peer reviewed journals in their area of specialization. Outcome of the study and analysis need to be presented as a thesis or research report with necessary experimental results.

4.6 Semester – wise Break up of Courses for 3 Year UG and 4 Year UG (Hons) Degree programmes:

Incorporating the focus of NEP in terms of different categories of courses and award of Certificates, Diplomas and Degrees during different stages of 4-Year Degree programmes, a template for Semester-wise course work was designed by the UGC and presented in para 5.3 of "Curriculum Framework".

Salient features of it are as follows:

a. Every Semester shall have a minimum of 20 credits worth of courses.
b. Credits for a course shall be decided on the basis of number of Contact hours of the teaching in a classroom. One credit means one hour of Teaching in case of Theory subject, one hour of Tutorial and at least 2 hours of conducting Practical hours in case of Lab subjects.
c. All Major and Minor disciplinary Courses shall have 4 credits with 6 hours of work load (including 2 hours of tutorials).
d. Language courses, ability enhancement, skill enhancement and value added common course also will have 2 hours of hands on training.
e. Students can exercise her choice for exiting the course at the end of every Academic year.
f. Semester I and II shall focus on introductory courses/subjects in Major/Minor disciplines and shall focus on providing knowledge in Multidisciplinary areas, skill enhancement and ability enhancement courses.
g. Semester III and IV shall focus on Core disciplinary courses with a focus on building strong foundation in the given Discipline.
h. Semester V and VI shall focus on providing in-depth knowledge and skills required for taking up a career in the given discipline.
i. Semester VII and VIII shall focus on Advanced knowledge and shall direct the students to take up socially relevant projects/Research works newer applications of the knowledge.

While directing the abovementioned requirements, UGC has designed a Template for each Semester.

5. Admissions:

As per the NEP, students shall be admitted to Undergraduate Programmes on basis of merit order in an All-India Admission Test like CUET, NEET, etc. However, the respective State/UT Governments shall decide the order of merit for admission of students for different courses offered at colleges.

6. Lateral Entry:

As per NEP, students have a choice of exit and entry into the Programme of Study multiple numbers of times. UGC specifies that about 10% of seats over and above the sanctioned strength shall be allocated to accommodate the Lateral Entry students. Detailed guidelines for lateral Entry would be finalized by the University/College.

7. Learning Assessment and Evaluation

7.1 EVALUATION:

Total Marks 100:

All Credit courses are evaluated for 100 marks. Internal Assessment component is for 25 marks and the End Semester exam is for 75 marks. In case of Practical's, Project work, etc., it is 50:50 marks for Internal and End-Semester Exams. However, for SEC's, Internal assessment for 50 marks and the examination conducted by the department for 50 marks accounts for total of 100 marks.

Break up of Internal Assessment marks:

Total Internal Assessment mark for a theory subject is 25 marks. The breakup is:

1	Mid Semester Exam (one)	20 Marks
2	Percentage of Attendance	5 Marks
Total Marks		25 Marks

Marks for Attendance are as follows:

Percentage of Attendance	Marks
Below 75%	0
75% - 80%	1
80% - 85%	2
85% - 90%	3
90% - 95%	4
95% - 100%	5

Internal Test Scheme:

Principal of the College schedules the Mid-Semester Exam for all courses during 8/9th week of start of classes. All faculty members are expected to conduct this Mid-Semester exam for 1.30 hr duration and evaluate, upload the marks to Controller of Examinations of University/College. Answer books of Mid-Semester exams may be preserved until declaration of results by the University/College.

Internal Assessment marks for Practical's/Project work/Internships subjects:

Faculty member in-charge of Lab practicals shall evaluate the practical subjects for 50 marks. The break up is as follows

a) Observation note/Demo note/Work dairy	20 marks
b) Practical Record/Internship Report	30 marks
Total	50 marks

Internal Assessment marks for Theory + Practical paper:

Internal Assessment	20 marks
Attendance	5 marks
Total	25 marks

Internal Assessment marks for SEC's:

Mid semester examination	20 marks
Viva voce	25 marks
Attendance	5 marks
Total	50 marks

Evaluation of Theory + Practical Courses:

End Semester Practical Examination	25 marks
End Semester Theory Examination	50 marks

Evaluation of Skill Enhancement Courses:

Faculty member in-charge of SEC shall evaluate the subject as follows:

Internal Assessment	50 marks
End semester examination conducted by the respective department	50 marks

7.2 End-Semester University/College Exam:

Controller of Examinations (COE) of Pondicherry University/College schedules the End-Semester exams for all theory and practical subjects based on University/College calendar. A detailed Exam Time Table shall be circulated to all students at least 15 days before the start of exams mostly during 15/16th week of the Semester. Question Papers shall be set externally based on BOS approved syllabus.

7.3 Criterion to appear in End Semester Examination:

Students who have a minimum of 70% attendance are eligible to attend the end-semester exams. Students those who have attendance percentage between 60% and 70% are allowed to take up the exams by paying a condonation fee with proper justification. Students with less than 60% of attendance are not eligible to appear in the end semester examination.

However, the student's eligibility to write exams will be decided by the regulations of the college/University is final.

7.4 The breakup of end semester marks:

a) Theory subjects (Sec A, Sec B and Sec C) Question from all units of syllabus	75 marks
b) Practical/Internship Project Work subjects (Based on Practical Exams/Presentation/Viva)	50 marks
c) Skill Enhancement Courses	50 marks

7.5 Question paper pattern for various types of courses

QUESTION PAPER PATTERN FOR THEORY COURSE

MAXIMUM MARKS: 75 MARKS

TIME: 3 HOURS

Question Paper Pattern for all Major (MJD)/Minor (MID) courses:

- Section - A: 10 Questions × 2 marks = 20 marks (10 out of 12 questions)
  (Question numbers 1 to 12)
- Section - B: 5 Questions × 5 marks = 25 marks (5 out of 8 questions)
  (Question numbers 13 to 20)
- Section-C: 3 Questions ×10 marks = 30 marks (3 out of 5 questions)
  (Question numbers 21 to 25)

Question Paper Pattern for all Minor courses for Physics/Chemistry/Computer Science:

- Section - A: 10 Questions × 2 marks = 20 marks (10 out of 12 questions)
  (Question numbers 1 to 12).
- Section - B: 5 Questions × 5 marks = 25 marks (5 out of 8 questions)
  (Question numbers 13 to 20).
- Section-C: 3 Questions ×10 marks = 30 marks (3 out of 5 questions)
  (Question numbers 21 to 25).

Question Paper Pattern for all Minor courses for B. Com (Corporate Secretaryship):

- Section – A: 5 Questions × 7 marks = 35 marks (5 out of 8 questions)
  (Question numbers 1 to 8).
  (3 Theory questions and 5 Problem questions)
- Section – B: 2 Questions × 20 marks = 40 marks (2 out of 4 questions)
  (Question numbers 9 to 12)
  (1 Theory question and 3 Problem questions).

Question Paper Pattern for Practical + Theory Courses:

- Section - A: 10 Questions × 2 marks = 20 marks (10 out of 12 questions)
  (Question numbers 1 to 12).
- Section - B: 5 Questions × 5 marks = 25 marks (5 out of 8 questions)
  (Question numbers 13 to 20).
- Section-C: 3 Questions ×10 marks = 30 marks (3 out of 5 questions)
  (Question numbers 21 to 25).

Question Paper Pattern for Skill Enhancement Course (SEC):

- Section – A: 5 Questions x 2 marks = 10 marks (5 out of 7 questions) (Question number 1 to 7)
- Section – B: 4 Questions x 5 marks = 20 marks (4 out of 6 questions) (Question number 8 to 13)
- Section – C: 2 Questions x 10 marks = 20 marks (2 out of 4 questions) (Question number 13 to16)

Question Paper Pattern for Multi-Disciplinary Course (MLDC) offered by Department of Mathematics to other Departments:

- Section - A: 10 Questions × 2 marks = 20 marks (10 out of 12 questions) (Question numbers 1 to 12).
- Section - B: 5 Questions × 5 marks = 25 marks (5 out of 8 questions) (Question numbers 13 to 20).
- Section - C: 3 Questions ×10 marks = 30 marks (3 out of 5 questions) (Question numbers 21 to 25).

Evaluation of Community Engagement Services and Summer Internship / Field Work:

As per NEP and UGC Guidelines on "Fostering Social Responsibility & Community Engagement in Higher Education Institutions in India 2.0 (https://www.ugc.gov.in/publication/ebook), evaluation of CESR and Summer Internship/Field Work will be based on the guidelines provided by the College/University.

8. Consolidation of Marks and passing Minimum

1. Controller of Examinations of the University/College consolidates the Internal Assessment marks and marks secured by students in end-semester examination. The total marks will be converted into letter grades as shown in section 10.1.

2. As per NEP Regulations, the passing minimum is 50% marks (IA + End semester put together). However, Pondicherry University/College considers 40% marks as pass during first 3 years of study and students who secured less than 50 will be awarded 'P' (Pass Grade).

9. Arrear Exam:

For first three years of study, A student who failed to secure 40% marks in aggregate is declared as Failed and she is eligible to take up supplementary examination by registering to the said course in the following Semester. For the fourth year, A student who failed to secure 50% marks in aggregate is declared as Failed and she is eligible to take up supplementary examination by registering to the said course in the following Semester. All other candidates who failed due to shortage of attendance, those who are seeking to improve the grade shall repeat the course.

10. Letter Grades and Calculation of CGPA:

10.1 Letter Grades

Total Marks Secured by a student in each subject shall be converted into a letter grade. UGC Framework has suggested a Country wide uniform letter grades for all UG courses. The following Table shows the seven letter grades and corresponding meaning and the grade points for calculation of CGPA.

Equivalent Letter Grade	Meaning	Grade Points for Calculation of CGPA
O	Outstanding	10
A+	Excellent	9
A	Very Good	8
B+	Good	7
B	Above Average	6
C	Average	5
P	Pass	4
F	Fail	0
Ab	Absent	0

In order to work out the letter grades, the regulations laid by the Controller of Examinations of the College / University will be followed.

However, Regulations laid by the Controller of Examinations of the college/ University will be the final guideline to evaluate or awarding of grades or awarding of degree to a student.

10.2 Calculation of Semester Grade Point average and CGPA:

Computation of SGPA and CGPA

The following procedure shall be followed to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e. **SGPA** (S_i) = Σ (C_i x G_i) / Σ C_i, Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

The CGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e. **CGPA** = Σ (C_i x G_i) / Σ C_i, Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

However, if any student fails more than once in the same subject, then while calculating CGPA, the credit and grade point related to the subject in which the student fails in multiple attempts will be restricted to one time only. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

In case of audit courses offered, the students may be given (P) or (F) grade without any credits. This may be indicated in the mark sheet. Audit courses will not be considered towards the calculation of CGPA.

11. Declaration of Results:

Controller of Examinations (COE) of the University/College shall declare the results of given UG programme by following the CGPA secured by students by the end of 6th Semester and 8th Semester.

PASS CLASSES

Range of CGPA	Result
9.0 above	First Class with distinction
6.0 above	First Class
5.0 Below 5.99	Second Class
4.0 to 4.99	Pass Class

12. Curriculum for UG Degree programme

Course Structure

SEMESTER – I

Level – 100

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 1		Calculus	4	5
2	MID 1		Trigonometry and Fourier Series	4	5
3	MLD 1		Offered by another Dept.	3	4
4	AEC 1		English	2	4
5	SEC 1		Quantitative Aptitude	3	4
6	VAC 1		Understanding India	2	4
7	VAC 2		Environmental Science/Education	2	4
Total				**20**	**30**

SEMESTER – II

Level - 100

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 2		Matrices and Theory of Equations	4	5
2	MID 2		Vector Calculus and Laplace Transform	4	5
3	MLD 2		Offered by another Dept.	3	4
4	AEC 2		Tamil/French/Hindi	2	4
5	SEC 2		Logical Reasoning	3	4
6	VAC 3		Digital Technology Education	2	4
7	VAC 4		Health, Wellness, Yoga Education, Sports & Fitness	2	4
Total				**20**	**30**

SEMESTER – III

Level-200

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 3		Real Analysis – I	4	5
2	MJD 4		Discrete Mathematics	4	5
3	MID 3		Mathematical Statistics – I	4	5
4	MLD 3		Offered by another Dept.	3	4
5	AEC 3		English	2	4
6	SEC 3		Latex	3	4
Total				**20**	**27**

SEMESTER – IV

Level – 200

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 5		Real Analysis – II	4	5
2	MJD 6		Group Theory	4	5
3	MJD 7		Differential Equations	4	5
4	MID 4		Mathematical Statistics – II	4	5
5	AEC 4		Tamil/French/Hindi	2	4
6	Project		Community Engagement and Services	2	6
Total				**20**	**30**

SEMESTER – V

Level – 300

S. No	Category	Course Code	Course Title	Credits	Lecture /Tutorial Hours
1	MJD 8		Summer Internship	4	5
2	MJD 9		Ring Theory	4	5
3	MJD 10		Complex Analysis – I	4	5
4	MJD 11		Programming in C Language	4	5
5	MID 5		Operations Research – I	4	5
Total				**20**	**25**

SEMESTER – VI

Level – 300

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 12		Graph Theory	4	5
2	MJD 13		Linear Algebra	4	5
3	MJD 14		Complex Analysis – II	4	5
4	MJD 15		Numerical Methods	4	5
5	MID 6		Operations Research – II	4	5
Total				**20**	**25**

SEMESTER – VII

Level – 400

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 16		Advanced Algebra	4	5
2	MJD 17		Topology	4	5
3	MJD 18		Differential Equations and Special Functions	4	5
4	MID 7		Calculus of Variations	4	5
5	MID 8		Integral Equations	4	5
Total				**20**	**25**

SEMESTER – VIII

Level-400

S. No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MJD 19		Advanced Real Analysis	4	5
2	MJD 20		Advanced Linear Algebra	4	5
3	Research Project (OR)		Research Project (OR)	12 (OR)	18 (OR)
4	MJD 21		1. Differential Geometry 2. Algebraic Number Theory 3. Advanced Topics in Topology and Analysis 4. Numerical Analysis for Ordinary Differential Equations 5. Advanced Topology 6. Integral Transforms and their Applications **Note: Students shall choose any of the above three courses if they do not opt for the Research Project / Dissertation.**	4	5
	MJD 22			4	5
	MJD 23			4	5
Total				**20**	**30/25**

Minor Disciplinary & Multi Disciplinary Courses offered to other Department by Department of Mathematics

SEMESTER – I / II / III

Multi-Disciplinary Course

S.No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MLDC		Mathematical Essentials	3	4

SEMESTER – I / II / III

Minor Disciplinary Courses for Department of Physics / Chemistry

S.No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MID 1		Mathematics for Chemistry I / Mathematics for Physics I	4	5
2	MID 2		Mathematics for Chemistry II / Mathematics for Physics II	4	5
3	MID 3		Mathematics for Chemistry III / Mathematics for Physics III	4	5

SEMESTER – I / II / III

Minor Disciplinary Course for Department of Computer Science

S.No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MID 1		Mathematical Foundations for Computer Science	4	5
2	MID 2		Mathematics for Data Science	4	5
3	MID 3		Probability and Statistics	4	5

SEMESTER – III / IV

Minor Disciplinary Course for Department of Corporate Secretaryship

S.No	Category	Course Code	Course Title	Credits	Lecture/Tutorial Hours
1	MID 1		Business Statistics – I	4	5
2	MID 2		Business Statistics – II	4	5

13. Syllabus

LIST OF MAJOR AND MINOR COURSES UNDER NEP

IN

B.Sc. MATHEMATICS PROGRAMME

(To be implemented from 2023 – 2024 onwards)

S. No.	Semester	Nature of the Course	Title of the Course	Credits	No. of Hrs. of Teachers
1	I	**Major 1**	Calculus	4	5
2		Minor 1	Trigonometry and Fourier Series	4	5
3		SEC 1	Quantitative Aptitudes	3	4
4		MLDC 1	(Offered by another Dept.)	3	4
5	II	**Major 2**	Matrices and Theory of Equations	4	5
6		Minor 2	Vector Calculus and Laplace Transform	4	5
7		SEC 2	Logical Reasoning	3	4
8		MLDC 2	(Offered by another Dept.)	3	4
9	III	**Major 3**	Real Analysis – I	4	5
10		**Major 4**	Elements of Discrete Mathematics	4	5
11		Minor 3	Mathematical Statistics – I	4	5
12		SEC 3	Latex	3	4
13		MLDC 3	(Offered by another Dept.)	3	4
14	IV	**Major 5**	Real Analysis – II	4	5
15		**Major 6**	Group Theory	4	5
16		**Major 7**	Differential Equations	4	5

17		Minor 4	Mathematical Statistics – II	4	5
18	V	**Major 8**	Summer Internship	4	5
19		**Major 9**	Ring Theory	4	5
20		**Major 10**	Complex Analysis – I	4	5
21		**Major 11**	Programming in C Language	4	5
22		Minor 5	Operations Research – I	4	5
23	VI	**Major 12**	Graph Theory	4	5
24		**Major 13**	Linear Algebra	4	5
25		**Major 14**	Complex Analysis – II	4	5
26		**Major 15**	Numerical Methods	4	5
27		Minor 6	Operations Research – II	4	5
28	VII	**Major 16**	Advanced Algebra	4	5
29		**Major 17**	Topology	4	5
30		**Major 18**	Differential Equations and Special Functions	4	5
31		Minor 7	Calculus of Variations	4	5
32		Minor 8	Integral Equations	4	5
33	VIII	**Major 19**	Advanced Real Analysis	4	5
34		**Major 20**	Advanced Linear Algebra	4	5
35		**Major 21**	7. Differential Geometry	4	5
36		**Major 22**	8. Algebraic Number Theory	4	5
37		**Major 23**	9. Advanced Topics in Topology and Analysis	4	5

			10. Numerical Analysis for Ordinary Differential Equations 11. Advanced Topology 12. Integral Transforms and their Applications **Note: Students shall choose any of the above three courses if they do not opt for the Research Project / Dissertation.**		

Minor Courses for B.Sc. Physics / Chemistry

38	I	Minor 1	Mathematics for Chemistry I / Mathematics for Physics I	4	5
39	II	Minor 2	Mathematics for Chemistry II / Mathematics for Physics II	4	5
40	III	Minor 3	Mathematics for Chemistry III / Mathematics for Physics III	4	5

Minor Course for B.Sc. Computer Science

41	I	Minor 1	Mathematical Foundations for Computer Science	4	5
42	II	Minor 2	Mathematics for Data Science	4	5
43	III	Minor 3	Probability and Statistics	4	5

Minor Course for B.Com. (Corporate Secretaryship)

44	III	Minor 1	Business Statistics – I	4	5
45	IV	Minor 2	Business Statistics – II	4	5

Multidisciplinary Course for other departments

46	I	MLDC	Mathematical Essentials	3	4

Syllabus for Major Courses

I YEAR: SEMESTER – I

MAJOR – 1: CALCULUS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn fundamental principles, concepts and knowledge in Differential and Integral Calculus.
2. To apply calculus in finding curvature and area of simple curves.

UNIT – I:

n^{th} derivative – Standard results – Trigonometric transformations – Formation of equation involving derivatives – Leibnitz's formula.

UNIT – II:

Total differential coefficients – Euler's theorem – Partial derivatives of function of two variables – Maxima and minima of two variables – Lagrange's method of undetermined multipliers.

UNIT – III:

Circle, Radius and Centre of curvature – Cartesian formula for radius of curvature – Evolute and Envelope.

UNIT – IV:

Integration of rational algebraic functions – Integration of irrational algebraic functions – Properties of definite integrals.

UNIT – V:

Integration by parts – Reduction formula – Bernoulli's formula – Evaluation of double integral (Cartesian form only) – Triple integral (Cartesian form only).

Textbooks:

1. S. Narayanan and T. K. Manicavachagom Pillay, **Calculus** (Vol. I and Vol. II), S. Viswanathan Printers & Publishers Pvt. Ltd. Chennai, (2004).

UNIT I: Chapter 3: Sec 1.2 – 1.6 and 2.1 (Vol. I), UNIT II: Chapter 8: Sec 1.3 – 1.7, 4 and 5 (Vol. I)

UNIT III: Chapter 10: Sec 2.2 and 2.5 (Vol. I), UNIT IV: Chapter 1: Sec 7.1, 8, 11 (Vol. II),

UNIV V: Chapter 1: Sec 12, 13, 15.1 and Chapter 5: 2.2, 4 (Vol. II).

Reference Books

1. Shanti Narayan, **Differential Calculus**, Shyamlal Charitable Trust, New Delhi, (2001).
2. Shanti Narayan, **Integral Calculus**, S. Chand & Co. New Delhi, (2001).
3. G.B.Thomas and R. L. Finney, **Calculus and Analytic Geometry**, Addison Wesley (9th Edition), Mass (Indian Print), (1998).
4. P. R. Vittal, **Calculus**, Margham Publication, Chennai, (2004).

I YEAR: SEMESTER – II

MAJOR – 2: MATRICES AND THEORY OF EQUATIONS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn fundamental matrix operations, forms, and properties and use them to solve linear systems and diagonalization.
2. To explore relationships between polynomial roots and coefficients and apply it to solve cubic and biquadratic equations.

UNIT – I:

Matrices – Elementary Row operations, Elementary Matrices and their Connection with Matrix Multiplication – The Echelon and Row Reduced Echelon forms of a Matrix – Row and Column Spaces and Rank – The solution of homogeneous systems of Linear Equations – The solution of nonhomogeneous Equations – The inverse Matrix.

UNIT – II:

Definition and statements of properties only for Symmetric, Skew Symmetric, Hermitian, Skew Hermitian, Orthogonal and Unitary Matrices – Eigen Values – Eigen Vectors – Cayley Hamilton Theorem – Similar matrices – Diagonalisation of a Matrix.

UNIT – III:

Relation between roots and coefficients of equation – Symmetric functions of the roots – Sum of the powers of roots, Newton's theorem on the sum of the powers of the roots.

UNIT – IV:

Transformation of equations – Roots with signs changed – Roots multiplied by a given number – Reciprocal equations – Nature of position of roots – Multiple roots – Sturm's Theorem.

UNIT – V:

Horner's Method – Cardan's Method for solving Cubic equations – Ferrari's Method for solving biquadratic equations.

Textbooks:

1. K. Hoffman and R. Kunze, **Linear Algebra**, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, (1971).
   UNIT I: Chapter 1: Sec 1.1- 1.5.
2. T. K. Manicavachagom Pillay, T. Natarajan and K. S. Ganapathy, **Algebra**, Volume 1 & 2, S. Viswanathan Printers & Publishers Pvt. Ltd. Chennai, (2004).
   UNIT II: Chapter 2: Sec 6.1 – 6.3, Sec 9.1, Sec 16, 16.1. (Vol. 2),
   UNIT III: Chapter 6: Sec 11-14 (Vol. 1), UNIT IV: Chapter 6: Sec 15-16, 24, 26, 27 (Vol. 1),
   UNIT V: Chapter 6: Sec 30, 34, 35 (Vol. 1).

Reference Books:

1. B. S. Grewal, **Higher Engineering Mathematics**, Khanna publishers, New Delhi, (2014).
2. S. Arumugam, **Algebra**, New Gamma Publishing house, Palayamkottai, (2003).
3. A. Singaravelu, **Algebra and Trigonometry**, Vol I & II, Meenakshi Agency, Chennai, (2003).

II YEAR: SEMESTER – III

MAJOR – 3: REAL ANALYSIS – I – 4 CREDITS (60 HOURS)

Course Objectives:

1. To understand the basic set theory and the ordering of the set of all real numbers.
2. To study about the sequence and series of real numbers along with their convergence.
3. To learn about the continuity and limits of function in Real line and metric spaces.

UNIT I:

Sets and elements – Operations on sets – Functions – Real valued functions – Equivalence – Countability – Real numbers – Least upper bound – Greatest lower bound.

UNIT II:

Definition of sequence and subsequence – Limit of a sequence – Convergent sequence – Bounded sequence – Monotone sequence – Operation on convergent sequence – Limit superior and limit inferior – Cauchy sequence.

UNIT III:

Convergence and divergence – Series with non-negative terms – Alternating series – Conditional convergence and absolute convergence – Tests for absolute convergence – Series whose terms form a non-increasing sequence – Summation by parts.

UNIT IV:

Limit of a function on the real line – Metric spaces (Examples 4 and 5 under 4.2c to be omitted) – Limits in metric spaces.

UNIT V:

Functions continuous at a point on the real line Reformulation – Functions continuous on a metric space – Open sets and closed sets – Discontinuous functions on R.

Textbooks:

1. Richard R. Goldberg, **Methods of Real Analysis**, John Wiley and Sons, Inc, New York, (1976).

   Unit 1: Chapter 1, Unit 2, 3: Chapter 2 and Chapter 3 (up to 3.8),
   Unit 4: Chapter 4, Unit 5: Chapter 5.

Reference Books:

1. Richard Courant and Fritz John, **Introduction to Calculus and Analysis,** Vol. I, Springer, (1999).
2. Robert G. Bartle and Donald R. Sherbert, Introduction **to Real Analysis**, 4th Edition, Wiley, (2014).

II YEAR: SEMESTER – III

MAJOR – 4: ELEMENTS OF DISCRETE MATHEMATICS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To develop a foundational understanding of number theory, including divisibility, prime numbers and the Euclidean algorithm.
2. Apply mathematical induction, recurrence relations and combinatorial methods to solve problems in sequences, counting and generating functions.
3. To explore propositional logic, predicate logic and the theory of inference.

UNIT – I:

The Integers – The Division algorithm – Divisibility – The Euclidean Algorithm – Prime numbers.

UNIT – II:

Mathematical induction – Weak form and strong form – Recursively defined sequences – Solving recurrence relations – The characteristic polynomials – Solving recurrence relations – Generating functions – The principle of inclusion-Exclusion – The addition and multiplication rules.

UNIT – III:

The pigeonhole principle – Permutations – Combinations – Repetitions – Derangements – The Binomial theorem.

UNIT – IV:

Introduction – TF Statements – Atomic and Compound statements – Well formed (Statement) Formulae – Truth table of formulae – Tautology – Tautological Implications and Equivalence of formulae – Replacement process – Functionally complete sets of connectives and Duality Law.

UNIT – V:

Normal Forms – Principal Normal Forms – Theory of Inference – Open statements – Quantifiers – Valid Formulae and Equivalence – Theory of Inference for Predicate Calculus – Statements involving more than one quantifier.

Text book:

1. T. Veerarajan, **Discrete Mathematics with Graph Theory and Combinatorics**, McGraw-Hill Education (India) Pvt Limited, (2006).
   UNIT I: Chapter 3, Pages 156-157, UNIT II and III: Chapter 6, Pages 314-345,
   UNIT IV and V: Chapter 1, Pages 1-33.

Reference Books:

1. Singaravelu and M. P. Jeyaraman, **Discrete Mathematics**, Meenakshi Agency, (2016).
2. Richard Johnsonbauth, **Discrete Mathematics** 5th Edition, Pearson Education Asia, New Delhi, (2002).
3. C. L. Lie, **Elements of Discrete Mathematics**, McGraw-Hill, Inc. India, (1985).

II YEAR: SEMESTER – IV

MAJOR – 5: REAL ANALYSIS – II – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn about the completeness and compactness of Metric spaces.
2. To develop an understanding of the Riemann Integral and its Properties.
3. To learn about several of types of functions and their behavior around a point.

UNIT – I:

Open sets – Connected sets – Bounded sets and totally bounded sets – Complete metric spaces.

UNIT – II:

Compact metric spaces – Continuous functions on compact metric Spaces – Continuity of the inverse function – Uniform continuity.

UNIT – III:

Sets of measure zero – Definition of the Riemann integral – Existence of the Riemann integral – Properties of the Riemann integral.

UNIT – IV:

Derivatives – Rolle's theorem – The Law of the Mean – Fundamental theorem of Calculus – Improper integrals.

UNIT – V:

Hyperbolic function – The exponential function – The logarithmic function – Definition of xa – The trigonometric function – Taylor Theorem – L' Hopital's rule.

Textbooks:

1. Richard R. Goldberg, **Methods of Real Analysis**, John Wiley and Sons, Inc, New York, (1976).

   Unit 1: 6.1 to 6.4
   Unit 2: 6.5 to 6.8
   Unit 3: 7.1 to 7.4
   Unit 4: 7.5 to 7.10
   Unit 5: 8.1 to 8.7

Reference Books

1. Dr. Somasundaram and B. Choudhyri, **First Course in Mathematical Analysis**, Narosa Publishing house, New Delhi, (1996).
2. Shanti Narayan, **Elements Real Analysis**, S. Chand, (1980).

II YEAR: SEMESTER – IV

MAJOR – 6: GROUP THEORY– 4 CREDITS (60 HOURS)

Course Objectives:

1. To understand groups and sub groups
2. To understand quotient groups- Homomorphism.

Unit I

Introduction to Groups - Definition and Examples of Groups – Elementary Properties of Groups – Subgroups - Subgroup Tests - Examples of Subgroups.

Unit II

Cyclic Groups - Properties of Cyclic Groups - Classification of Subgroups of Cyclic Groups - Permutation Groups - Cycle Notation - Properties of Permutations.

Unit III

Isomorphisms - Cayley's Theorem - Properties of Isomorphisms – Automorphisms - Properties of Cosets - Lagrange's Theorem and Consequences.

Unit IV

External Direct Products – Properties of External Direct Products - The Group of Units Modulo *n* as an External Direct Product - Normal Subgroups - Factor Groups - Applications of Factor Groups - Internal Direct Products.

Unit V

Group Homomorphisms - Properties of Homomorphisms - The First Isomorphism Theorem - Fundamental Theorem of Finite Abelian Groups - The Isomorphism Classes of Abelian Groups.

Text Book:

1. Joseph A. Gallian, Contemporary Abstract Algebra, 8th Edition, Cengage Learning India Private Limited.

   Unit I - Chapter 2 to Chapter 3, Unit II - Chapter 4 to Chapter 5 (Except Digital scheme),

   Unit III - Chapter 6 to Chapter 7 (except 7.4 and 7.5)

Unit IV - Chapter 8 to Chapter 9

Unit V - Chapter 10 to Chapter 11

Reference Books:

1. M. Artin, **Algebra**, Prentice-Hall of India, 1991.
2. J. B. Fraleigh, **A First Course in Algebra** (3rd Edition), Addison Wesley. Mass. (Indian Print), (1986).
3. I.N. Herstein, **Topics in Algebra**, Wiley India, 2017.
4. M. L. Santiago, **Modern Algebra**, Tata McGraw Hill, New Delhi, (2002).
5. David S. Dummit, Richard M. Foote, **Abstract Algebra**, 2nd Ed, Wiley, (2008)

II YEAR: SEMESTER – IV

MAJOR – 7: DIFFERENTIAL EQUATIONS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To understand ordinary and first order partial differential equations and their applications.
2. To enable students to solve the first and second order ODEs and first order PDEs.

UNIT – I:

ODEs; Leibnitz's linear equations – Bernoulli's equations – Exact Differential equations – Equations solvable for *p*-solvable for *y*-solvable for *x* – Clairut's equation, Modelling; Orthogonal trajectories of curves.

UNIT – II:

Linear Differential Equations with constant co-efficients – Method of variation of parameters – Linear Differential Equations with variable co-efficients – Wronskian. Modelling; Simple pendulum.

UNIT – III:

Simultaneous linear equations with constant co-efficient – Total Differential Equations – Simultaneous Total Differential Equations – Equations of the form $dx/P=dy/Q=dz/R$. Modelling; Series solution when $x=0$ is an ordinary point of the equation.

UNIT – IV:

PDEs; Formation of PDEs – Solutions of PDE – Linear equations of the first order – Non-linear equations of the first order – Charpit's method.

UNIT – V:

Homogeneous linear equations with constant co-efficients – Non-Homogeneous linear equations. Modelling; D'Alembert's solution of the wave equation.

Textbooks:

1. B. S. Grewal, **Higher Engineering Mathematics** 44th Edition, Khanna Publishers, Delhi, (2014).
   Unit I: 11.9-12.3, Unit II: 13.1-13.8 and 14.3
   Unit III: 13.9-13.11, 15.8-15.10 and 16.3
   Unit IV: 17.1-17.7, Unit V: 17.8-17.12 and 18.4

Reference Books:

1. Gupta, Malik, Mittal, **Ordinary and Partial Differential Equations**, 20thEdition, S. Chand, (2020).
2. Erwin Kreyszig, **Advanced Engineering Mathematics**, 8th Edition, Wiley India Pvt. Limited, (2006).
3. Shankara Rao, **Introduction to Partial Differential Equations**, 3rd Edition, Prentice Hall India Learning Pvt. Limited, (2011).

III YEAR: SEMESTER – V

MAJOR – 8: SUMMER INTERNSHIP – 4 CREDITS (60 HOURS)

As per NEP and UGC Guidelines on "Fostering Social Responsibility & Community Engagement in Higher Education Institutions in India 2.0 (https://www.ugc.gov.in/publication/ebook), evaluation and procedure of CESR and Summer Internship/Field Work will be based on the guidelines provided by the College/University.

III YEAR: SEMESTER – V

MAJOR – 9: RING THEORY – 4 CREDITS (60 HOURS)

Course Objectives:

1. To develop a comprehensive understanding of the foundational concepts of rings.
2. To understand polynomial rings over fields and commutative rings.

UNIT – I:

Introduction to Rings - Motivation and Definition of Rings – Examples of Rings – Properties of Rings – Subrings - Definition and Examples of Integral Domains – Fields - Characteristic of a Ring.

UNIT – II:

Ideals - Factor Rings - Prime Ideals and Maximal Ideals - Definition and Examples of Ring Homomorphisms - Properties of Ring Homomorphisms - The Field of Quotients.

UNIT – III:

Polynomial Rings - The Division Algorithm and Consequences - Principal ideal domain - Factorization of Polynomials - Reducibility Tests - Irreducibility Tests.

UNIT – IV:

Unique Factorization in Z[x] - Weird Dice: An Application of Unique Factorization - Divisibility in Integral Domains – Irreducibles and Primes.

UNIT – V:

Historical Discussion of Fermat's Last Theorem - Unique Factorization Domains - Euclidean Domains.

Textbooks:

1. Joseph A. Gallian, **Contemporary Abstract Algebra**, 8th Edition, Cengage Learning India Private Limited.

   UNIT I: Chapter 12 AND 13, UNIT II: Chapter 14 and 15, UNIT III: Chapter16 and first sections in Chapter 17, UNIT IV: From Section 3 of Chapter 17 to First section of Chapter 18, UNIT V: Chapter 18

Reference Books:

1. I. N. Herstein, **Topics in Algebra** (Second Edition), Wiley Estern Ltd., New Delhi, (1989).
2. J. B. Fraleigh, **A First Course in Algebra,** (3rd Edition) Addison Wesley. Mass. (Indian Print), (1986).
3. M. L. Santiago, **Modern Algebra**, Tata McGraw Hill, New Delhi, (2002).
4. David S. Dummit and Richard M. Foote, **Abstract Algebra** (Third Edition), John Wiley and sons, 2004.

III YEAR: SEMESTER – V

MAJOR – 10: COMPLEX ANALYSIS – I – 4 CREDITS (60 HOURS)

Course Objectives:

1. To understand complex numbers and it's properties.
2. To study the concepts of analytic functions and explore various types of transformations.

UNIT – I:

Complex numbers – Definitions – Algebraic properties – Cartesian co-ordinates – Triangular inequality – Polar Form – Powers and roots – Region in the complex plane.

UNIT II:

Analytic functions – Functions of a complex variable – Mapping – Limit – Theorems on limits – Continuity – Derivatives – Differentiation formula – Cauchy Riemann equations – Sufficient conditions.

UNIT III:

Cauchy Riemann equations in polar form – Analytic functions – Harmonic functions.

UNIT IV:

Elementary functions – Exponential function – Trigonometric functions and their properties – Hyperbolic functions – Logarithmic function – Branches – Properties of logarithms – Complex exponents – Inverse trigonometric and hyperbolic functions.

UNIT V:

Mapping by elementary functions – The linear function $1/z$ – Linear fractional transformation – The function $w = \exp(z)$, $w = \sin z$, $w = \cos z$, $z^{1/2}$ – Successive transformation $w = z + 1/z$.

Textbooks:

1. James Ward Brown and Ruel V Churchill, **Complex Variables and Applications**, McGraw - Hill, International Edition (2009).

   UNIT I – Chapter 1, UNIT II – Chapter 2, UNIT III – Chapter 2, UNIT IV – Chapter 3,
   UNIT V – Chapter 4.

Reference Books:

1. John B. Conway, **Functions of one complex variable**, Second Edition, Springer- Verlag, (1978).
2. Lars V. Ahlfors, **Complex Analysis**, Third Edition, McGraw Hill, Inc., (1979).
3. P. Duraipandian and Kayalal Pachaiappa, **Complex Analysis**, S. Chand & Co., (2014)
4. S. Ponnusamy, **Foundations of Complex Analysis**, (2^{nd} Edition), Narosa, (2011).
5. V. Karunakaran, **Complex Analysis**, (2^{nd} Edition), Narosa, (2005).

III YEAR: SEMESTER – V

MAJOR – 11: PROGRAMMING IN C LANGUAGE– 4 CREDITS (60 HOURS)

Course Objectives:

1. **Develop Proficiency in C Programming**: Gain a solid understanding of the fundamental concepts of C programming, including data types, variables, arithmetic expressions, and decision-making constructs, to build a strong foundation for writing efficient code.
2. **Master Advanced C Programming Techniques**: Explore advanced topics such as arrays, pointers, strings, structures, and user-defined functions to enhance problem-solving skills and develop robust C programs.

UNIT I:

Declaratives, Assignment and Variables – Integer Arithmetic Expressions: Arithmetic Operators, Uses of Parentheses, Modulus and Unary Minus Operator – Data Types in C.

UNIT II:

Relational Operators, Logical Operators and their Precedence if, if. else, Nesting of if statements – Conditional (while, do…while) and unconditional (for, nesting of for) looping – Increment and decrement Operators – Boolean Values.

UNIT III:

Printf and scanf functions – Conversions specifications – User Define Functions: Functions, Local and Global Variables, Parameters, Boolean Functions.

UNIT IV:

Arrays – Declaration and Initialization – Break statement – Strings and Character Arrays – Sorting an Array – Multidimensional Arrays – Pointers.

UNIT V:

Concept of a Structure Period Operator, Initializing a Structure, Arrays of Structures, Structures within Structure.

Textbooks:

1. E. Balagurusamy, **Programming in ANSI C**, Tata McGraw Hill, New Delhi, (1996).
   Unit I – Chapter: 1, 2 & 3, Unit II – Chapter: 5 & 6, Unit III – Chapter: 4 & 9,
   Unit IV – Chapter: 7 & 8, Unit V – Chapter: 8 & 10.

Reference Books

1. V. Rajaraman, **Computer Programming in C**, Prentice Hall. New Delhi, (1995)
2. H. Schildt, **Teach Yourself C**, Osborne/McGraw Hill. New York, (1994).

III YEAR: SEMESTER – VI

MAJOR – 12: GRAPH THEORY – 4 CREDITS (60 HOURS)

COURSE OBJECTIVES:

1. To introduce the notion of graphs and analyze fundamental graph concepts.
2. To study the properties of Eulerian, Hamiltonian, planar and non-planar graphs.

UNIT I:

Graphs – Subgraphs – Isomorphism of graphs – Degrees of Vertices – Paths and Connectedness – Automorphism of a Simple Graph – Trees – Centers and Centroid.

UNIT II:

Counting the Number of Spanning Trees – Cayley's Formula – Vertex Cuts and Edge Cuts – Connectivity and Edge-connectivity.

UNIT III:

Vertex Independent sets and Vertex Coverings – Edge-Independent Sets – Matchings and Factors – M-Augmenting Paths – Matchings in Bipartite Graphs – Halls Theorem on Bipartite graphs – Tutte's 1-Factor Theorem (without proof).

UNIT IV:

Eulerian graphs – Necessary and sufficient condition for Eulerian graphs – Hamiltonian graphs – Dirac theorem – Closure of a graph.

UNIT V:

Vertex Coloring – Chromatic Number – Critical Graphs – Brooks' Theorem – Edge Colorings of Graphs – Vizing's Theorem (without proof) – Planar and Nonplanar Graphs – Euler's Formula and its Consequences.

Text Books:-

1. R. Balakrishnan and K. Ranganathan, **A Textbook of Graph Theory**, Second Edition, Springer New York 2012.

Chapter 1: 1.1-1.6 Chapter 3: 3.1-3.3

Chapter 4: 4.1-4.5 Chapter 5: 5.1-5.5

Chapter 6: 6.1-6.3 Chapter 7: 7.1, 7.2, 7.3.1, 7.6.2

Chapter 8: 8.1-8.3.

Reference Books:

1. J. A. Bondy and U.S.R Murthy, **Graph Theory with Applications**, Macmillan Press Ltd, New Delhi, (1976).
2. Douglas B. West, **Introduction to Graph Theory**, Second Edition, PHI Learning Private Ltd, New Delhi, (2011).

III YEAR: SEMESTER – VI

MAJOR – 13: LINEAR ALGEBRA – 4 CREDITS (60 HOURS)

Course Objectives:

1. To understand vector spaces and dependence among vectors.
2. To learn about linear transformations and its canonical forms.

UNIT I:

Abstract Algebra Concepts – Groups- Subgroups- Fields- examples Vector space- Subspace-linear combinations and systems of linear equations- Linear dependence and linear independence- Basis and dimension.

UNIT II:

Linear Transformations- Null spaces- Range spaces- Dimension theorem- Matrix representation of linear transformation- composition of linear transformations and Matrix multiplication- Invert ability and Isomorphism- The change of coordinate matrix.

UNIT III:

Elementary matrix Operations and elementary matrices- The rank of a matrix and matrix inverses- systems of linear equations- Theory and computation

UNIT IV:

Determinants of order 2 and order n - properties of determinants- Important facts about determinants-Eigen values and Eigen vectors- Diagonalizability- Invariant spaces and Cayley- Hamilton theorem.

UNIT V:

Inner products and norms- The Gram-Schmidt orthogonalisation process and orthogonal complements.

Text Book:

1. Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence**, Linear Algebra,** 4th Edition, Prentice Hall of India Pvt. Ltd., 2006.

Unit I: 1.2 to 1.6, Unit II: 2.1 to 2.5

Unit III: 3.1 to 3.4, Unit IV: 4.1 to 4.4 and 5.1 to 5.2, 5.4, Unit V: 6.1, 6.2

Reference Books

1. I.N. Herstein, **Topics in Algebra**, Wiley India, (2003).
2. F. Lipschutz, **Beginning Linear Algebra**, Tata McGraw Hill Edition, New Delhi, (2005).
3. S. Kumaresan, **linear Algebra: A Geometric Approach,** Prentice Hall India Learning Private Limited, (2000).

III YEAR: SEMESTER – VI

MAJOR – 14: COMPLEX ANALYSIS – II – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn about contour integrals and its applications.
2. To study the convergence of sequences and series and gain insights into singularities, residues and poles of complex functions and applying it to solve real integrals.

UNIT I:

Contour integrals – Examples – The Cauchy Goursat's theorem – A preliminary lemma – Proof of Cauchy Goursat's theorem – Simply and multiple connected domains.

UNIT II:

The Cauchy integral formula – Derivatives of analytic functions – Morera's theorem – Maximum moduli of functions – Liouville's theorem – The fundamental theorem of algebra.

UNIT III:

Convergence of sequences and series and examples – Laurent Series (statement only) – Taylor series – Observations.

UNIT IV:

Singularities – Definitions and examples – Residues – The residue theorem – The principal part of a function – Residues and poles – Zeros and poles of order *m*.

UNIT V:

$$\text{Type 1}: \int_{-\infty}^{\infty} \frac{p(x)}{q(x)}\,dx, \quad \text{Type 2}: \int_{-\infty}^{\infty} \frac{p(x)}{q(x)} \sin ax\, dx \text{ (or) } \int_{-\infty}^{\infty} \frac{p(x)}{q(x)} \cos ax\, dx, \quad \text{Type 3}: \int_{0}^{2\pi} F(\sin\theta,\ \cos\theta)\, d\theta$$

where $p(x)$ and $q(x)$ are real polynomials with no factor in common and $q(x)$ has no real zeros.

Textbooks:

1. James Ward Brown and Ruel V Churchill, **Complex Variables and Applications**, McGraw-Hill International Edition, (1990).

   Unit I: Chapter 4: Section 34-38, Unit II : Chapter 4: Section 39-43

   Unit III: Chapter 5: Section 44-48, Unit IV: Chapter 6: Section 53-57

   Unit V : Chapter 6: Section 58-60

Reference Books:

1. John B. Conway, **Functions of one complex variable**, Second Edition, Springer- Verlag, (1978).
2. Lars V. Ahlfors, **Complex Analysis**, Third Edition, McGraw Hill, Inc., (1979).

3. P. Duraipandian and Kayalal Pachaiappa, **Complex Analysisn,** First edition, S.Chand & Co., (2014).
4. S. Ponnusamy, **Foundations of Complex analysis**, Second Edition, Narosa, (2011).
5. V. Karunakaran, **Complex Analysis**, Second Edition, Narosa, (2005).

III YEAR: SEMESTER – VI

MAJOR – 15: NUMERICAL METHODS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To solve linear algebraic equations and to understand interpolation techniques.
2. To learn numerical differentiation and integration and solving ordinary differential equations numerically.

UNIT – I: Numerical Solution of Simultaneous Linear Algebra Equations:

Gauss Elimination Method – Gauss – Jordan Elimination Method – Gauss Jacobi Iteration Method - Gauss Seidal Iteration Method

UNIT – II: Finite Differences:

Forward Differences – Backward Differences – Divided Differences – Shift Operator, Relation Between Operators – Differences of Polynomial – Factorial Polynomial.

UNIT – III: Interpolation:

Newton – Gregory Forward and Backward Interpolation for equal intervals – Newton's Divided Differences formula and Lagrange's Interpolation Formula for Unequal Intervals.

UNIT – IV:

Numerical Differentiation: Derivatives Using Newton's Forward Difference Formula.

Numerical Integration: Newton's – Cote's Quadrature Formula – Trapezoidal Rule – Simpson's 1/3 Rule.

UNIT – V: Numerical Solution of Ordinary Differential Equations:

Picard's Method – Taylors Method – Euler's Method – Modified Euler's Method – Runge Kutta Method of Second and Fourth Order (Only First Order Differential Equations).

Textbooks:

1. Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathi, **Numerical Methods**, S. Chand., (2006).

   Unit I – Chapter 4: Sections 4.2, 4.2.1, 4.4 and 4.9, Unit II – Chapter 5: Sections 5.1-5.4,
   Unit III – Chapter 6: Sections 6.1 – 6.7, 8.1 – 8.7, Unit IV – Chapter 9: Sections 9.1, 9.2, 9.7-9.11 and 9.13, Unit V – Chapter 11: Sections 11.5, 11.8- 11.10, 11.12 and 11.13.

Reference Books:

1. M. K. Venkataraman, **Numerical Methods in Science and Engineering,** The National Publishing Company, Madras, (1999).
2. B.S. Grewal, **Numerical Methods in Engineering and Science**, MLI, (2019).

IV YEAR: SEMESTER – VII
MAJOR – 16: ADVANCED ALGEBRA – 4 CREDITS (60 HOURS)

Course Objectives:

1. To understand fundamental concepts of group theory, including isomorphisms, group actions, and alternating groups.
2. To analyse group structures, automorphisms.
3. To study the properties of Polynomial rings.

UNIT – I:

The isomorphism theorems – Composition Series – Transpositions and Alternating groups.

UNIT – II:

Group Actions: Group Actions and Permutation representations – Group acting on themselves by left multiplication – Cayley's theorem.

UNIT – III:

Group acting on themselves by conjugation – The class equation – Automorphisms – The Sylow theorems – The simplicity of A_n.

UNIT – IV:

Direct and semi-direct products and abelian groups: Direct products – The fundamental theorem of finitely generated abelian groups.

UNIT – V:

Polynomial rings: Definitions and basic properties – Polynomial rings over fields – Polynomial rings that are unique factorization domains – Irreducible criteria.

Textbooks:

1. David S. Dummit and Richard M. Foote, **Abstract Algebra** (Third Edition), John Wiley and sons, 2004.
   Unit I - Chapter 3 - Sections 3.3 to 3.5, Unit II Chapter 4 - Sections 4.1, 4.2, Unit III 4.3to 4.6, Unit IV - Chapter 5 - Sections 5.1 and 5.2, Unit V - Chapter 9 - Sections 9.1 to 9.4

Reference Books:

1. M. Artin, **Algebra**, Prentice-Hall of India, 1991.
2. N. Herstein, **Topics in Algebra**, Wiley Eastern Ltd., New Delhi, 1975.
3. N. Jacobson, **Basic Algebra**, Volumes I & II, W. H. Freeman, 1980.

IV YEAR: SEMESTER – VII
MAJOR – 17: TOPOLOGY – 4 CREDITS (60 HOURS)

Course Outcome:

1. To understand topological spaces.
2. To analyze compactness and connectedness of topological spaces.

UNIT – I:

Revision of sets – Functions – Product of sets – Relations – Countable sets – Uncountable sets – Partially ordered sets and lattices – Metric spaces – Definition and examples – Open sets and closed sets in metric spaces – Open subsets of real line.

UNIT – II:

Topological spaces – Definitions and examples – Closure and related concepts – Open bases and open sub bases – Separability and second count ability – Lindloff's Theorem.

UNIT – III:

Compactness – Basic results – Continuous maps on compact sets – Characterization of compactness by basic and sub basic open covers – Tychonoff's theorem – Generalized Heine-Borel theorem.

UNIT – IV:

Compactness for metric spaces – Sequential compactness – Lebesgue covering lemma – Sequential compactness and compactness coincide on metric spaces – T_1 spaces – Hausdorff spaces.

UNIT – V:

Completely regular spaces and normal spaces – Urysohn's lemma and Tietze extension theorem – Connected spaces – Components of a space.

Textbooks:

1. G. F. Simmons, **An Introduction to Topology and Modern Analysis**, McGraw-Hill Kogakusha, Tokyo, 1963.

   UNIT I: Sections 1-3, Sections 4-8, 9-12,
   UNIT II: Sections 16, 17 and 18,
   UNIT III: Sections 21 – 23,
   UNIT IV: Sections 24, 26,
   UNIT V: Sections 27,28,31,32.

Reference Books:

1. J. R. Munkres, **Toplogy**, Pearson Education Inc., Second Edition, 2000.
2. Stephen Willard, **General Topology**, Dover Publication, 2004.
3. J. Dugundgi, **Toplogy**, Allyn and Bacon, Boston, 1966.
4. Fred. H. Croom, **Principles of Topology**, Dover publications, 2016.

IV YEAR: SEMESTER – VII
MAJOR – 18: DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To solve ordinary differential equations using special functions.
2. To study the existence and uniqueness of solutions of first order ODEs.

UNIT – I:

Qualitative properties of solutions – The Sturm Separation Theorem – The Sturm comparison theorem – Eigen values and Eigen functions and vibrating string. Series solutions of first order equations – Second order linear equations – Ordinary points – Regular singular points.

UNIT – II:

Gauss Hypergeometric equations, Gauss's hypergeometric and Confluent hypergeometric functions – Integral representations – Differentiation formulas – Transformation formulas – Summations formulas.

UNIT – III:

Legendre polynomials – Properties of Legendre polynomials – Bessel functions – The Gamma function - Properties of Bessel Function.

UNIT – IV:

Linear systems – Homogeneous linear system with constant coefficients.

UNIT – V:

The existence and uniqueness of solutions – The method of successive approximations – Picards's theorem.

Textbooks:

1. G. F. Simmons, **Differential Equations with Applications and Historical Notes**, 2nd Edition, McGraw Hill Education (India) Company, 2003. Sections: 22-30, 32-35, 37-355-56.

   UNIT I: Chapter-4, Sections: 25, Chapter-5, Sections: 26, 27, 28, 29, 30 & Chapter -7, Sections: 40, UNIT II: Chapter-5, Sections: 31, UNIT III: Chapter-8, Sections: 44, 45, 46 & 47 UNIT IV: Chapter-10, Sections: 55 & 56, UNIT V: Chapter-13, Sections: 68 & 69

Reference Books:

1. Earl Coddington and Norman Levinson, **Theory of ordinary Differential equations**, TATA McGraw Hill, 2017.
2. E. D. Rainville, **Special functions**, Macmillan, New York, 1960.
3. N. M. Temme, **Special functions: An introduction to the classical functions of mathematical physics**, John Wiley& Sons, New York, 1996.

IV YEAR: SEMESTER – VIII
MAJOR – 19: ADVANCED REAL ANALYSIS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn and use convergence of sequence and series of functions in real analysis to find approximation of functions.
2. To apply the differentiability of functions to analyze the functions of several variables.

UNIT – I:

Functions of bounded variation – Double sequences – Double series – Rearrangement theorem for double series – A sufficient condition for the equality of iterated series.

UNIT – II:

Sequence and Series of functions – Examples – Uniform convergence and Continuity – Uniform convergence and Integration – Uniform convergence and Differentiation – Double sequences and series – Iterated limits – Equicontinuous Families of Functions – Arzela – Ascoli Theorem.

UNIT – III:

The Weierstrauss theorem for algebraic polynomials – The Stone-Weierstrauss Theorem – Power Series – The Exponential and Logarithmic Functions – The Trigonometric Functions – Fourier Series – The Weierstrauss theorem for the Trigonometric polynomials.

UNIT – IV:

Functions of Several Variables – Linear Transformation – Differentiation – The Contraction Principle.

UNIT – V:

The inverse function Theorem – The implicit Function Theorem – The Rank Theorem – Determinants.

Textbooks:

1. Apostol, **Mathematical Analysis**, Narosa Publishing House, Indian edition, 2002.
   UNIT I: Chapter: 6 and Sections: 8.20 to 8.23, 8.26 and8.27 of [1]
2. Walter Rudin, **Principles of Mathematical Analysis** - McGraw Hill International Editions, Mathematics series, 1976.
   UNIT II: Chapter: 7 of [2], Subsections 7.1 to 7.25
   UNIT III: Chapter: 7 of [2] subsections: 7.26 to7.33 and chapter 8 of [2]
   UNIT IV: Chapter: 9 of [2], Subsections: 9.6 to 9.23
   UNIT V: Chapter: 9 of [2], Subsections: 9.24 to 9.38

Reference Books:

1. Patrick M. Fitzpatrick, **Advanced Calculus**, Amer. MATH. Soc. Pine and Applied Undergraduate Texts, Indian Edition, 2009.
2. N. L. Carothers, **Real Analysis**, Cambridge University Press, 2000.
3. G. F. Simmons, **Introduction to Topology and Modern Analysis**, McGraw Hill, 2017.

IV YEAR: SEMESTER – VIII
MAJOR – 20: ADVANCED LINEAR ALGEBRA – 4 CREDITS (60 HOURS)

Course Objectives:

1. To develop an understanding of field theory, transformations and using it to reduce to simpler forms.
2. To study canonical forms and real quadratic forms.

UNIT – I:

Field theory: Splitting fields and Algebraic closures. The Algebra of linear transformations – Characteristic roots – Similarity of linear transformations.

UNIT – II:

Invariant subspaces and matrices – Reduction to triangular forms.

UNIT – III:

Nilpotent transformations – Index of nil potency and invariant of nilpotent transformation – Jordan blocks and Jordan forms.

UNIT – IV:

Modules – Cyclic modules – Fundamental theorem on modules over PID – Rational canonical form – Trace – Transpose and Determinants.

UNIT – V:

Hermitian – Unitary and Normal transformations – Real quadratic forms.

Textbooks:

1. I. N. Herstein, **Topics in Algebra**, Wiley Eastern Ltd., New Delhi, 1975.
2. David S. Dummit and Richard M. Foote, **Abstract Algebra**, Third Edition,
   UNIT I: Sections – 6.1, 6.2, 6.3 [1] and 13.1-13.2 [2]
   UNIT II: Sections – 6.4 and 6.5 [1]
   UNIT III: Sections – 6.6 and 4.5 [1]
   UNIT IV: Sections - 6.7, 6.8 and 6.9 [1]
   UNIT V: Sections – 6.10 and 6.11 [1]

Reference Books:

1. M. Artin, **Algebra**, Prentice-Hall of India, 1991
2. N. Jacobson, **Basic Algebra**, Volumes I & II, W. H. Freeman, 1980.
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, **Basic Abstract Algebra** (2^{nd} Edition) Cambridge University Press, Indian edition, 1997
4. Kenneth Hoffmann and Ray Kunze, **Linear Algebra**, (2^{nd}), Pearson, 2015
5. S. Friedberg, A. Insel and L. Spence, **Linear Algebra**, (4^{th} Edition) Pearson, 2015.

IV YEAR: SEMESTER – VIII

MAJOR 21, MAJOR 22, MAJOR 23 shall be chosen from the following MAJOR subjects

DIFFERENTIAL GEOMETRY – 4 CREDITS (60 HOURS)

Course Objectives:

1. To explore fundamental concepts of space curves and surface theory.
2. To understand the behavior of curves and surfaces.

UNIT – I:

Curves – arc length – Reparametrization – Level curves – Curvature – Plane curves.

UNIT – II:

Space curves – Torsion – Serret-Frenet equations – Simple closed curves – The Isoperimetric Inequality – The Four vertex Theorem.

UNIT – III:

Smooth surface – Tangents, normal and orient ability – Examples of surfaces – Quadratic surfaces – Triple orthogonal systems – Applications of Inverse function theorem.

UNIT – IV:

Lengths of curves on surfaces – First fundamental form – Isometries of surfaces – Conformal mapping of surfaces – Surface area – Equiareal maps and a theorem of Archimedes.

UNIT – V:

The Second Fundamental form – The Curvature of curves on a surface – The normal and principal curvature – Euler's theorem – The geometric interpretation of principal curvatures.

Textbooks:

1. Andrew Pressley, **Elementary Differential Geometry**, Springer, 2004.
   UNIT I: Sections: 1.1 to 1.4 and Sections 2.1,2.2, UNIT II: Sections 2.3 and Sections 3.1 to 3.3.
   UNIT III: Sections 4.1 to 4.7, UNIT IV: Sections: 5.1 to 5.5, UNIT V: Sections: 6.1 to 6.4

Reference Books:

1. Christian Bar, Elementary **Differential Geometry**, Cambridge University Press, 2011.
2. Thomas F. Banchoff and Stephen T. Lovett, **Differential Geometry of Curves and Surfaces**, A.K Peters/CRC press, 2010.
3. W. Klingenberg, **A course in Differential Geometry**, Springer-Verlag, New York, 1978.

IV YEAR: SEMESTER – VIII
ALGEBRAIC NUMBER THEORY – 4 CREDITS (60 HOURS)

Course Objectives:

1. To apply unique factorization theorem to solve equations and analyze Fermat numbers.
2. To explore advanced concepts in algebraic structures.

UNIT – I: Elementary Number Theory

Integers – Greatest common divisor – Infinitude of primes – Unique factorization in Z – Fermat's little theorem – Euler's Φ function and Euler's theorem – Multiplicative property of Φ function – Applications of unique factorization – The equation $x^2 + y^2 = z^2$ – The equation $x^4 + y^4 = z^2$ – The equation $x^4 – y^4 = z^2$ – Fermat numbers and their properties.

UNIT – II: Euclidean Rings

Preliminaries: Units, Associates, Irreducible elements, Norm map, Unique factorization domain, Principal ideal domain, Euclidean domain – Gauss' lemma – Gaussian integers – Units and primes in the ring of Gaussian integers – Eisenstein integers – Units in the ring of Eisenstein integers – Factorization of 3 – Order of $Z[\rho] / (\lambda)$.

UNIT – III: Algebraic Numbers and Integers

Basic concepts – Algebraic number – Algebraic integer – Minimal polynomial Count ability of algebraic numbers – Liouville's theorem for R – Algebraic number fields – Theorem of the primitive element – Liouville's theorem for C – Characterization of algebraic integers.

UNIT – IV: Integral Bases

The norm and the trace – Integral basis for an algebraic number field – Algebraic integers of $Q(\sqrt{} – 5)$ – Existence of an integral basis – Discriminant of an algebraic number field – Index – Determination of an integral basis for the ring of integers of a quadratic number field.

UNIT – V: Dedekind Domains

Integral closure – Integrally closed ring – Noetherian ring – Dedekind domain – Characterizing Dedekind domains.

Textbooks:

1. J. E. Smonde and M. RamMurty, **Problems in Algebraic Number Theory, Graduate Texts in Mathematics**, Volume 190, Springer Verlag, New York,1999.

   UNIT I: Sections 1.1 and 1.2
   UNIT II: Sections 2.1, 2.2 and 2.3
   UNIT III: Sections 3.1, 3.2 and 3.3
   UNIT IV: Sections 4.1, 4.2 and 4.3
   UNIT V: Sections 5.1 and 5.2

Reference Books:

1. Pierre Samuel and Allan J Silberger, **Algebraic Theory of Numbers**, Dover Pub. Inc, 2008.

IV YEAR: SEMESTER – VIII
ADVANCED TOPICS IN TOPOLOGY AND ANALYSIS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To analyze quotient spaces and learn about locally compact and connected spaces.
2. To learn about the properties of $L_p[a,b]$.

UNIT – I:

Quotient topology and quotient maps – Examples of quotient spaces – Path connectedness – Standard results – Example of a connected but not path connected space – Locally connected spaces.

UNIT – II:

The Uryshon's metrization theorem – Locally compact spaces – One point compactification – Stone-Cech compactification – The uniform metric on Y_J and the Space filling curve.

UNIT – III:

Local finiteness – Countably locally finite refinement of open coverings of metric spaces – Paracompactness – Standard results – Metric spaces are paracompact.

UNIT – IV:

L_p-space – Completeness – Dual of L_p $[a, b]$ for $1 \leq p \leq \infty$.

UNIT – V:

Weak sequential convergence of L_p $[a, b]$ – the Riemann Lebesgue lemma – the Radon Riesz theorem – Weak sequential compactness of L_p $[a, b]$.

Textbooks:

1. James R. Munkres, **Topology**, Pearson, 2nd edition, 2000.
2. H. L. Royden, and P.M. Fitzpatrick, **Real Analysis**, (Fourth Edition) PHI Learning Private Limited, 2013.

   UNIT I: Sections 22, 25, relevant parts from section 24 of [1]

   UNIT II: Sections29, 34, 38, 43, 44 of [1]

   UNIT III: Sections 39, 40, 41 of [1], UNIT IV: Chapter: 7 of [2]

   UNIT V: Sections 8.1, 8.2 and 8.3 from Chapter: 8 of [2]

Reference Books:

1. James Dugundji, **General Topology**, Allyn and Bacon, Inc. (1966).
2. Inder K. Rana, **An Introduction to Measure Theory and Integration**, (2e), Narosa (2007).
3. B.V. Limaye, **Functional Analysis**, Wiley Eastern, New Delhi, 1981.

IV YEAR: SEMESTER – VIII

NUMERICAL ANALYSIS FOR ORDINARY DIFFERENTIAL EQUATIONS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To solve ordinary differential equations numerically using various methods.
2. To explore advanced methods for numerical differentiation and integration.
3. To study the stability and error control of numerical methods.

UNIT – I:

Euler's method – Trapezoidal rule – Theta method.

UNIT – II:

Adams – Bashforth method – Order and convergence – Backward differentiation formula.

UNIT – III:

Gaussion quadrature – Explicit Runge-Kutta scheme – Implicit Runge Kutta scheme – Collocation.

UNIT – IV:

Stiff equations – Linear stability domain and A- Stability – A-stability of RK and multistep methods.

UNIT – V:

Error Control – Milne Device – Embedded Runge Kutta method.

Textbooks:

1. Arieh Iserles, **A First Course in the Numerical Analysis of Differential Equations**, Cambridge University press, 2nd edition, 2008.

Reference Books:

1. Richard L. Burden and J.Douglas faires, **Numerical Analysis** (9th Edition), Cengage Learning India, 2012.

IV YEAR: SEMESTER – VIII
ADVANCED TOPOLOGY – 4 CREDITS (60 HOURS)

Course Objectives:

1. To analyze and investigate advanced topological structures.
2. To explore topological structures using homotopy and fundamental groups.

UNIT – I:

Connected components – Local connectedness – Locally path connected spaces – Local compactness, One point Compactification, Uryshon Metrization Theorem.

UNIT – II:

Nets and Filters – Quotient topology – Introduction to topological groups.

UNIT – III:

The Stone – Cech Compactification – Locally finite spaces – Nagata - Smirnov Metrization theorem – Paracompactness – Smirnov Metrization theorem.

UNIT – IV:

The Peano space – filling curve – Barie Spaces – Nowhere differentiable functions.

UNIT – V:

Homotopy of paths – The fundamental group – Covering spaces – The fundamental group of the circle.

Textbooks:

1. James R. Munkres, **Topology**, Second edition, Pearson Education Inc., (2002).
2. K. D. Joshi, **Introduction to General Topology**, First edition (revised), New Age International Publishers, 2004.

   UNIT I: Sections- 25 and 29 of [1]

   UNIT II: Chapter-10 of [2] and Sections- 22 and 36 of [1]

   UNIT III: Sections-38, 39, 40, 41 and 42 of [1]

   UNIT IV: Sections-44 48 and 49 of [1]

   UNIT V: Sections 48, 49, of [1]

Reference Books:

1. Stephen Willard, **General Topology**, Dover, 2004.

IV YEAR: SEMESTER – VIII
INTEGRAL TRANSFORMS AND THEIR APPLICATIONS
– 4 CREDITS (60 HOURS)

Course Objectives:

1. To solve differential and partial differential using Laplace, Hankel and Mellin transforms.
2. To study and understand about Z – transform with properties and to apply for solving the difference equations.

UNIT – I: Laplace Transforms

Laplace transforms - Definition and Examples, Basic Properties of Laplace Transforms, The Convolution Theorem and Properties of Convolution, Differentiation, and Integration of Laplace Transforms. The Inverse Laplace Transform and Examples, Tauberian Theorems and Watson's Lemma.

UNIT – II: Applications of Laplace Transforms

Applications of Laplace Transforms to the Solutions of Ordinary Differential Equations, Partial Differential Equations, Initial and Boundary Value Problems.

UNIT – III: Hankel Transforms

Introduction, The Hankel Transform and Examples, Operational Properties of the Hankel Transform, Applications of Hankel Transforms to Partial Differential Equations.

UNIT – IV: Mellin Transforms

Introduction, Definition of the Mellin Transform and Examples, Basic Operational Properties of Mellin Transforms, Applications of Mellin Transforms, Application of Mellin Transforms to Summation of Series.

UNIT – V: Z Transforms

Introduction, Dynamic Linear Systems and Impulse Response, Definition of the Z Transform and Examples, Basic Operational Properties of Z Transforms, The Inverse Z Transform and Examples, Applications of Z Transforms to Finite Difference Equations.

Textbooks:

1. Lokenath Debnath and Dambaru Bhatta, **Integral Transforms and Their Applications**, Third Edition, CRC Press, Taylor and Francis Group, A Chapman and Hall Book, 2015.
   UNIT I: Sections-3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8
   UNIT II: Sections-4.1, 4.2, 4.3
   UNIT III: Sections-7.1, 7.2, 7.3, 7.4
   UNIT IV: Sections- 8.1, 8.2, 8.3, 8.4, 8.6
   UNIT V: Sections-12.1, 12.2, 12.3, 12.4, 12.5, 12.6

Reference Books:

1. Ian N. Snedden, **The Use of Integral Transforms**, McGraw Hill, 1972
2. B. Davies, **Integral Transforms and Their Applications**, Springer, Texts in Applied Mathematics 41, Third Edition, 2009.
3. Alexander D. Poularikas, **Transforms and Applications Handbook**, Third Edition, CRC Press, Taylor and Francis Group, 2010.

Syllabus for Minor Courses

I YEAR: SEMESTER – I

MINOR – 1: TRIGONOMETRY AND FOURIER SERIES – 4 CREDITS (60 HOURS)

Course Objectives:

1. To study the expansions of trigonometric and hyperbolic functions.
2. To compute Fourier series of periodic functions.

UNIT – I: EXPANSIONS OF TRIGONOMETRY FUNCTIONS:

Expansions of $\cos n\theta$, $\sin n\theta$ – Expansions of $\tan n\theta$ in Terms of $\tan\theta$ – Expansion of $\tan(A+B+C+.....)$ – Powers of sines and cosines of θ in terms of functions of multiples of θ – Expansion of $\sin\theta$ and $\cos\theta$ in series of ascending powers of θ.

UNIT – II: HYPERBOLIC FUNCTIONS:

Definition – Relation between Hyperbolic Functions – Inverse Hyperbolic Functions.

UNIT – III: TRIGONOMETRIC SERIES:

Logarithm of Complex Quantities – Summation of Trigonometric Series: Method of Differences – Gregory Series – Euler Series.

UNIT – IV: FOURIER SERIES:

Definition – Dirichlets condition – Finding Fourier coefficient for a given periodic function with period 2π – Odd and even functions – Simple problems.

UNIT – V: HALF RANGE FOURIER SERIES:

Half-range series – Change of interval – Pareval's Theorem – Fourier series in complex form – Simple problems.

Basic Textbooks:

1. S. Narayanan and T. K. Manicavachagom Pillay, **Trigonometry**, S. Viswanathan Printers & Publishers Pvt. Ltd. Chennai, (2004).
2. B. S. Grewal, **Higher Engineering Mathematics**, Khanna Publishers, New Delhi, (2002).
   UNIT I: Chapter III – Sections 1 – 5 [1]
   UNIT II: Chapter IV – Sections 1, 2 (2.1, 2.2), 2.3[1]
   UNIT III: Chapter V: Section 5 (5.1, 5.2) and Chapter VI – Sections 3 (3.1, 3.2) [1]
   UNIT IV: Sections 10.1, 10.2, 10.3, 10.6 (Except 10.4) [2]
   UNIT V: Sections 10.5, 10.7, 10.9 (Except Root mean square value), 10.10 (Except 10.8) [2].

Reference Books:

1. S. Duraipandian and Laxmi Duraipandian, **Trigonometry**, Emerald Publishers, Chennai, (1984).
2. T. K. Manicavachagom Pillay and S. Narayanan, **Calculus**, Vol. III, Vijay Nicholas Company, Chennai, (2010).

I YEAR: SEMESTER – II

MINOR – 2: VECTOR CALCULUS AND LAPLACE TRANSFORM – 4 CREDITS

(60 HOURS)

Course Objectives:

1. To understand the fundamental concepts of vector calculus.
2. To learn about Laplace transform.

UNIT – I:

Differentiation of vectors – Differentiation formulae – Differentiation of dot and cross product – Partial derivatives of vectors – Del (Δ) – Gradient of a Scalar Function – Directional Derivative.

UNIT – II:

Divergence of a Vector – Curl of a vector – Solenoidal and Irrotational Fields – Line integral – Surface and Volume Integrals.

UNIT – III:

Green's theorem – Gauss divergence theorem – Stokes' theorem (Statement only) – Verification of the above theorems using simple problems only.

UNIT – IV:

Definition of Laplace transform – Transform of 1 – Laplace transform of e^{at}, e^{-at}, $\cos at$, $\sin at$, $\cosh at$, $\sinh at$, and t^n $(n > 0)$: Simple problems – Laplace transform of derivatives – Laplace transform of integrals – First shifting theorem – Change of scale property – Laplace transform of function multiplies by *t* – Divisible by *t*.

UNIT – V:

Laplace transform of periodic function – Inverse Laplace transform – Convolution theorem – Solution of ordinary differential equations – Simple problems.

Basic Textbooks:

1. P. R. Vital, **Vector Analysis, Analytical Solid Geometry and Sequence and Series**, Margham Publication, (2010).
2. B. S. Grewal, **Higher Engineering Mathematics**, Khanna publishers, New Delhi, (2002).
   UNIT I: Chapter 1: Pages 1 – 22[1], UNIT II: Chapter 1: Pages 22 – 89 [1]
   UNIT III: Chapter 1: 89 – 141 [1]
   UNIT IV: Chapter 21: Sections 21.1-21.4, 21.7-21.11 [2],
   UNIT V: Chapter 21: Sections 215, 21.12-21.15 [2].

Reference Books:

1. Susan Jane Colley, **Vector Calculus**, Fourth Edition, Pearson Education, Inc., (2012).
2. M. L. Khanna, **Vector Calculus**, Jai Prakash Nath and Co., Eighth Edition (1986).
3. P. R. Vital and V. Malini, **Vector Analysis**, Margham Publications, Chennai, (2004).
3. T. K. Manicavachagom Pillai and S. Narayanan, **Calculus**, Vol. II, Vijay Nicholas Company, Chennai, (2005).

II YEAR: SEMESTER – III

MINOR – 3: MATHEMATICAL STATISTICS – I – 4 CREDITS (60 HOURS)

Course Objective:

1. To learn basic concepts of probability theory and solve simple problems.
2. To identify various special probability distributions and use them to solve problems.

UNIT – I: Theory of Probabilities

Basic terminology – Mathematical or Classical probability – Statistical or Empirical probability – Axiomatic approach to probability – Some theorems on probability (except Boole's Inequality) – Conditional probability Multiplication theorem of probability – Independent events – Multiplication theorem of probability for independent events – Extension of Multiplication theorem of probability to *n*-events – Baye's theorem.

UNIT – II: Random Variables and Distribution Functions

Introduction – Distribution function – Discrete random variable – Continuous random variable – Two dimensional random variables.

UNIT – III: Mathematical Expectations

Introduction – Expected Value of a random variable – Expected value of a function of a random variable – Properties of expectation – Properties of Variance – Covariance – Moments of bi-variant probability distributions – Conditional expectations and conditional variance – Moment generating function – Characteristic functions Chebyshev's inequality.

UNIT – IV: Special Discrete Probability Distributions

Bernoulli distribution – Binomial distribution – Poisson distribution – Geometric distribution.

UNIT – V: Special Continuous Probability Distribution

Normal distribution – Rectangular distribution.

Basic Textbooks:

1. S. C. Gupta & V. K. Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand & Sons, (2002).

Unit I : Chapter 3: Sec (3.3-3.5, 3.8-3.9 (Omit 3.9.3), 3.10-3.14) Chap 4: Sec 4.2.

Unit II : Chapter 5: Sec 5.1-5.5 (Omit 5.4.2, 5.5.5 and 5.5.7),

Unit III: Chapter 6: Sec 6.1-6.9 (Omit 6.7), Chapter 7: Sec 7.1, (Omit 7.1.3),
7.3 (Omit 7.3.2, 7.3.3, 7.3.4) and 7.5

Unit IV: Chapter 8: Sec 8.3-8.4 (Omit 8.4.3, 8.4.4, 8.4.5, 8.4.9, 8.4.10, 8.4.11, 8.4.12),
8.5 (Omit 8.5.3, 8.5.7, 8.5.9, 8.5.10) and 8.7,

Unit V : Chapter 9: Sec 9.2 (Omit 9.2.3, 9.2.4, 9.2.6, 9.2.10, 9.2.12, 9.2.14, 9.2.15), 9.3 (Omit 9.3.4).

Reference Books:

1. S. P. Gupta, **Statistical Methods**, Chand & Co., (2005).
2. A. M. Mood, F. A. Gray Bill and D.C. Boas, **Introduction to the Theory of Statistics**, Tata-McGraw Hill Publishing Company, New Delhi (2001).

II YEAR: SEMESTER – IV

MINOR – 4: MATHEMATICAL STATISTICS – II – 4 CREDITS (60 HOURS)

Course Objective:

1. To learn the concept of statistical relationship between data.
2. To formulate and analyse the significance of difference between data using various tests of hypothesis.

UNIT – I: Correlation:

Bi-variate distribution – correlation – Scatter diagram – Karl Pearson's coefficient of correlation – Limits for correlation coefficient – Assumption underlying Karlpearson's correlation coefficient – Calculation of correlation coefficient for a bivariate frequency distribution – Probable error of correlation coefficient – Rank correlation – Tied ranks – Repeated ranks – Repeated ranks (contd) – Limits for rank.

UNIT – II: Regression Analysis:

Regression – Lines of regression – Regression coefficient – Properties of regression coefficients – Angle between two lines of regression and Simple Problems.

UNIT – III: Theory of Attributes:

Introduction – Notations – Dichotomy – Classes and class frequencies – Order of classes and class frequency – Relation between class frequency – Class symbols as operators – Consistency of data – Conditions for consistency of data – Independent of attributes – Criterion of independence – Symbols $(AB)_o$ and δ (Delta) – Association of attributes – Yule's Coefficient of association – Coefficient of colligation.

UNIT – IV: Tests of Significance (Large Samples):

Sampling introduction – Types of sampling – Parameter and Static – Test of significance – Null hypothesis – Errors in sampling – Critical region and level of significance – Test of significance for large samples – Sampling of attributes – Test of significance of single mean – Test of significance for difference of means – Test of significance for difference of standard deviations.

UNIT – V: Tests of Significance (Small Samples):

Chi- Square variant (definition) – Chi-Square test of goodness of fit-independence of attributes – Yates' correction. Student t-distribution (definition) – t-test for single mean – t-test for difference of means – t-test for testing significance of an observed sample correlation.

Basic Textbooks:

1. S. C. Gupta and V. K. Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand and Sons, New Delhi, (2003).
   UNIT I: Chapter 10,
   UNIT II: Chapter 11: Sec: 11.1 - 11.2.3,
   UNIT III: Chapter 13,
   UNIT IV: Chapter 14: Sec 14.1 -14.7 (omit 14.8.1), 14.8.2 - 14.8.5,
   UNIT V: Chapter 15 & 16: 15.1 - 15.6: 15.6.1 - 15.6.3, 16.2, 16.3.1- 16.3.4, 16.5.

Reference Books:

1. S.P. Gupta, **Statistical Methods**, Chand and Co., New Delhi (2000).
2. R.V. Hogg and Tanis, **Probability and Statistical Inference**, Pearson, New Delhi (2002).
3. A.M. Mood, F.A. Gray Bill and D.C. Boas, **Introduction to the Theory of Statistics**, Tata-McGraw Hill Publishing Company, New Delhi (2001).

III YEAR: SEMESTER – V

MINOR – 5: OPERATIONS RESEARCH – I – 4 CREDITS (60 HOURS)

Course Objectives:

1. To provide a scientific basis to the decision makers.
2. To introduce various techniques to make informed decision.

UNIT – I: Linear Programming:

Formulation – Basic, Feasible, Basic Feasible Solutions (Maximization and Minimization models) – Canonical and Standard form of LPP – Simplex method – Alternative Optima – Unbounded and Infeasible Solution.

UNIT – II: Linear Programming (continued):

Big M method – Two-Phase method – Degeneracy – Duality – Primal – Dual Relationships – Dual Simplex Method.

UNIT – III: Transportation Problem:

North-West Corner Method – least Cost Method – Vogel Approximation method (Unit cost penalty method) – Unbalanced Transportation problem, Degeneracy in Transportation Problem – MODI Method (Modified Distribution Method) Maximization Problem in Transportation.

UNIT – IV: Assignment Problem:

Mathematical Formulation of an Assignment Problem – Different Solution Methods to find solution of assignment problem – Variations of Assignment Problem – Travelling Salesman Problem.

UNIT – V: Decision Theory:

Decision Making under uncertainty: Laplace, Savage, Hurwitz criteria – Decision Making under Conditions of risk expected value criterion Expected Opportunity Loss Criterion – Expected Value of Perfect information – EVM for items that have a Salvage value.

Textbooks:

1. Kanti Swarup, P. K. Gupta and Man Mohan, **Operation Research**, Sultan Chand, 2010.

   UNIT I: Chapter 2: 2.1 - 2.4, Chapter 3: 3.1 - 3.6, Chapter 4: 4.1-4.3.
   UNIT II: Chapter 4: 4.4, 4.5, Chapter 5: 5.1, 5.2, 5.3, 5.7 and 5.9.
   UNIT III: Chapter 10: 10.1 - 10.15, UNIT IV: Chapter 11: 11.1 - 11.7.
   UNIT V: Chapter 16: 16.1 - 16.6.

Reference Books:

1. V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan, **Resource Management Techniques – Operations Research**, A. R. Publication, Arpakkam – 609 111.
2. J. K. Sharma, **Operation Research: Theory and Applications**, Macmillan, Delhi, (2001).
3. P. R Vital, **Operation Research**, Margham Publishers, Chennai, (2003).

III YEAR: SEMESTER – VI

MINOR – 6: OPERATIONS RESEARCH – II – 4 CREDITS (60 HOURS)

Course Objectives:

1. To introduce scientific techniques to formulate a real-life problem.
2. To learn methods to make decisions based on mathematical logic and techniques.

UNIT – I: Sequencing Problem:

Introduction - Problem of Sequencing - Basic Terms used in Sequencing – Processing *n* Jobs through Two machines – Processing *n* Jobs through *k* machines – Processing 2 Jobs through *k* machines (Graphical Method).

UNIT – II: Network Scheduling By PERT/CPM:

Introduction – Network: Basic Components – Logical Sequencing- Rules of Network Construction – Concurrent Activities – Critical Path Analysis – Probability Consideration in PERT – Distinction between PERT and CPM.

UNIT – III: Queueing Theory:

Introduction – Operating Characteristics of a Queuing System – Definition of Transient and Steady States – Poisson Queuing Systems: Model I {(M/M/1):(∞/FIFO)}, Model III {(M/M/1):(N/FIFO)}, Model V {(M/M/C):(∞/FIFO)} (Problem Restricted only for C = 2).

UNIT – IV: Inventory Control I:

Introduction - Costs Associated with Inventories - Factors Affecting Inventory Control - The Concept of EOQ - Deterministic Inventory Problems with No Shortages.

UNIT – V: Games and Strategies:

Introduction – Two-person zero-sum games – Some Basic terms - The Maximin-Minimax Principles – Games Without Saddle Points – Mixed Strategies – Graphic Solution of 2 x n and m x 2 Games – Dominance Property – Arithmetic Method for *n* x *n* Games – General Solution of *m* x *n* Rectangular Games.

Basic Textbooks:

1. Kanti Swarup, P.K. Gupta and Man Mohan, **Tracts in Operations Research - Operation Research**, S. Chand, (2009).
   UNIT I: Chapter 12: Sections 12.1 - 12.6.
   UNIT II: Chapter 25: Section: 25.1 - 25.8.
   UNIT III: Chapter 21: Section: 21.1 - 21.9 (Omit 21.2, 21.3, 21.5, 21.6, 21.7).
   UNIT IV: Chapter 19: Section: 19.1 - 19.10 (Omit 19.2, 19.3, 19.4, 19.5. 19.8).
   UNIT V: Chapter 17: Section: 17.1 - 17.9.

Reference Books:

1. V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan, **Resource Management Techniques – Operations Research**, A. R. Publication, Arpakkam – 609 111.
2. J. K. Sharma, **Operation Research: Theory and Applications**, Macmillan, Delhi, (2001).
3. P. R Vital, **Operation Research**, Margham Publishers, Chennai, (2003).

IV YEAR: SEMESTER – VII

MINOR – 7: CALCULUS OF VARIATIONS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To solve variational problems by Euler's equation and to understand canonical form of Euler equations.
2. To understand and solve the variational problems functionals depending on higher order derivatives.

UNIT – I:

Functionals – Some simple variational problems – The variation of a functional – A necessary condition for an extremum – The simplest variational problem – Euler's equation – The case of several variables – A simple variable end point problem – The variational derivative – Invariance of Euler's equation.

UNIT – II:

The fixed end point problem for *n*-unknown functions – Variational problem in parametric form – Functionals depending on higher order derivatives –Variational problems with subsidiary conditions.

UNIT – III:

The general variational of a functional – Derivation of the basic formula – End points lying on two given curves or surfaces – Broken extremals – The Weierstrass Erdmann conditions.

UNIT – IV:

The canonical form of Euler equations – First integrals of the Euler equations – The Legendre transformation – Canonical transformations – Noether's Theorem – The principle of least action – Conservation laws – The Hamilton Jacobi equation – Jacobi theorem.

UNIT – V:

The second variation of a functional – The formula for the second variation, Legendre conditions – Sufficient conditions for a weak extremum.

Basic Textbooks:

1. I. M. Gelfand and S. V. Fomin, **Calculus of Variations**, Dover Publications, 2000.
   UNIT I: Chapter 1
   UNIT II: Chapter 2
   UNIT III: Chapter 3
   UNIT IV: Chapter 4
   UNIT V: Chapter 5

Reference Books:

1. A. S. Gupta, **Calculus of Variations with Applications**, Prentice-Hall of India, 2008.
2. M. L. Krasnov, G. I. Makarenko and A. I. Kiselev, **Problems and Exercises in the Calculus of Variations**, Mir Publishers, Moscow 1975.

IV YEAR: SEMESTER – VII

MINOR – 8: INTEGRAL EQUATIONS – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn about the classification of integral equations.
1. To solve integral equations using different methods.

UNIT – I:

Introduction – Classification of integral equation – Examples - IVP for ODE.

UNIT – II:

BVP for ODE – BVP for elliptic PDE – Abel's problem.

UNIT – III:

Second order ODE and integral equations – Differential equation theory – Initial value problems – Boundary value problems – Singular boundary value problems.

UNIT – IV:

Integral equations of the second kind – Introduction – Degenerate kernels – A different approach.

UNIT – V:

Operators – Newmann series.

Basic Textbooks:

1. Porter and Stirling, **Integral equations**, **A practical treatment from spectral theory to applications**, Cambridge University Press, 1996.

Reference Books:

1. M. D. Rai Singhania, **Integral Equations and Boundary Value Problems**, S. Chand, 2007.

I YEAR: SEMESTER – I / II / III

MULTI DISCIPLINARY COURSE (MLDC)

Offered by DEPARTMENT of MATHEMATICS

MLDC: MATHEMATICAL ESSENTIALS– 3 CREDITS (48 HOURS)

Course Objectives:

1. Develop Foundational Arithmetic Skills and Enhance Problem-Solving abilities.

UNIT I:

Number System, including various types of numbers, their properties, and operations, the computation of the Highest Common Factor (H.C.F.) and the Least Common Multiple (L.C.M.) of numbers, Decimal Fractions.

UNIT II:

Mathematical operations, including Simplification techniques, Efficient methods for calculating Square Roots and Cube Roots using Vedic mathematics and a comprehensive understanding of Averages.

UNIT III:

Problem-solving, Problems on Numbers, Problems on Ages and Time and Distance.

UNIT IV:

Problems on trains, Time and work, Percentage calculations and the principles of Profit and Loss.

UNIT V:

Logarithms, Simple and compound, Permutation and combination.

Text book:

1. R. S. Agarwal, **Quantitative Aptitude**, S. Chand, (2017).

References:

1. Abhijit Guha, **Quantitative Aptitude**, McGraw Hill Edu. Pvt. Ltd, (2011).
2. R.S. Agarwal, **Verbal and Non-Verbal Reasoning**, S. Chand, (2010).
3. **Fundamentals and Applications of Vedic Mathematics**, State Counsel of Educational Research and Training, Varun Marg, Defense Colony, New Delhi – 110024, (2024).

SYLLABUS FOR SKILL ENHANCEMENT COURSES

I YEAR: SEMESTER – I

SEC-1: QUANTITATIVE APTITUDE - 3 CREDITS (48 HOURS)

Course Objectives:

1. To Build Core Arithmetic Skills**.**
2. To Enhance Problem-Solving Abilities.

Unit 1: Fundamentals of Arithmetic

Foundational principles of arithmetic, covering the Number System, various types of numbers, their properties, and operations. Highest Common Factor (H.C.F.) and the Least Common Multiple (L.C.M.) of numbers, Decimal Fractions.

Unit 2: Basic Mathematical Operations

Mathematical operations, Simplification techniques, Methods for calculating Square Roots and Cube Roots and Averages.

Unit 3: Problem Solving

Problem-solving skills by wide range of numerical problems, Problems on Numbers, Problems on Ages, and Surds and Indices.

Unit 4: Advanced Arithmetic

Logarithms, Percentage calculations and the principles of Profit and Loss.

Unit 5: Review and Application

Ratio and Proportion, Partnership, and the Chain Rule for interconnected problem-solving.

Textbook:

1. R. S. Agarwal, **Quantitative Aptitude**, S. Chand, (2017).

References:

1. Abhijit Guha, **Quantitative Aptitude**, McGraw Hill Edu. Pvt. Ltd, (2011).

I YEAR: SEMESTER – II

SEC 2: LOGICAL REASONING - 3 CREDITS (48 HOURS)

Course Objectives:

1. To develop logical thinking and problem-solving abilities through various topics.
2. To enhance critical thinking and decision-making skills.

Unit 1: Series Completion

Number Series, Alphabet Series and Alpha-Numeric Series.

Unit 2: Analogy

Analogous Pair, Simple Analogy, Choosing the Analogous pair, Double Analogy, Word Analogy and Number Analogy.

Unit 3: Classification / Odd One Out

Word Classification, Number Classification, and Letter Classification, patterns and outliers.

Unit 4: Coding – Decoding

Letter Coding, Number Coding, Matrix Coding, Substitution, Deciphering Message Word Codes, and Jumbled Coding, enhancing code-based problem-solving skills.

Unit 5: Blood Relations and Time Sequence Test

Relation Puzzles, including Direction Sense Tests, Ranking and Time Sequence Tests, Arithmetical Reasoning, and Mathematical Operations.

Textbook:

1. R.S. Agarwal, **Verbal and Non-Verbal Reasoning,** S. Chand, (2010).
2. Abhijit Guha, **Quantitative Aptitude**, McGraw Hill Education Pvt. Ltd, (2011).

II YEAR: SEMESTER – III

SEC 3: LATEX - 3 CREDITS (48 HOURS)

Course Objectives:

1. To develop basic LaTeX documents with proper formatting and structure, and style them according to academic standards as demonstrated in Learning LaTeX.
2. To utilize advanced LaTeX functionalities to create complex mathematical documents and presentations, drawing on the knowledge provided in Learning LaTeX.

Unit 1: Introduction to LaTeX

Motivation for Learning LaTeX, Running LaTeX, Resources for LaTeX.

Unit 2: Basic LaTeX

Sample Document and Key Concepts, Type Style in LaTeX, LaTeX Environments: Lists, Centering, Tables, Verbatim, Managing Vertical and Horizontal Spacing.

Unit 3: Typesetting Mathematics

Examples of Mathematical Typesetting, Equation Environments in LaTeX, Fonts, Hats, and Underlining in Mathematical Notation, Using Braces, Arrays, and Matrices, Creating Customized Commands, Theorem-like Environments in LaTeX, Miscellaneous Mathematical Notation and Styles.

Unit 4: Further Essential LaTeX

Document Classes and Document Structure, Titles for LaTeX Documents, Sectioning Commands, Miscellaneous Extras: Spacing, Accented Characters, Dashes, Hyphens, Quotation Marks, Troubleshooting LaTeX: Error Identification and Common Errors.

Unit 5: More About LaTeX

Introduction to LaTeX Packages, Inputting External Files, Inserting Pictures and Graphics, Creating Bibliographies, Generating an Index, Exploring the History of LaTeX, Exploring Online LaTeX Resources and Professional Societies.

Text Book:

1. David F. Griffiths and Desmond J. Higham, **Learning LaTeX**, Siam, Philadelphia, 2016.

MINOR COURSE FOR B.Sc. CHEMISTRY/PHYSICS

OFFERED BY DEPARTMENT OF MATHEMATICS

I YEAR: SEMESTER – I

MINOR 1: MATHEMATICS FOR PHYSICS – I / MATHEMATICS FOR CHEMISTRY – I

(4 CREDITS) (60 HOURS)

Course Objectives:

1. To understand and apply key concepts in Matrices and Trigonometry.
2. To solve first order ordinary differential equations and simple partial differential equations.

UNIT I: ALGEBRA

Matrices - Rank of a Matrix – Test for consistency of simultaneous non – homogeneous equations – Eigen values and Eigen vectors – Cayley-Hamilton Theorem (without proof).

UNIT II: TRIGNOMETRY

Hyperbolic functions – Relations between Hyperbolic functions and circular functions – Inverse Hyperbolic functions – Separate into Real and Imaginary parts – Logarithm of a Complex number – Definition of Principal value of a Logarithm (Simple problems only).

UNIT III: ORDINARY DIFFERENTIAL EQUATION OF THE FIRST ORDER

Definitions – Solutions of differential equations – Formation of differential equations – Equations of the first order and the first degree (Variable Separable, Linear equations) – Bernoulli's equations, Exact Equations.

UNIT IV: ORDINARY DIFFERENTIAL EQUATION

First order higher degree equations, Equations solvable for $p = \frac{dy}{dx}$, Equations solvable for y and x, Clairaut's form.

UNIT V: PARTIAL DIFFERENTIAL EQUATIONS

Notation of Partial Derivative – Derivation of Partial Differential Equation – Elimination of Arbitrary function – Different Integrals of Partial Differential Equation – Standard types of first order equation – Lagrange's Equation.

Text Books:

1. T. K. Manikavachagom Pillay, Narayan, R. Hanumantha Rao, Dr. P. Kandaswamy, **Allied Mathematics** course of B.Sc. Physics and Chemistry, (Vol. I and Vol. II), S. Viswanathan (Printers and Publishers) PVT limited, (2008).
2. S. Narayanan, T. K. Manicavachagom Pillay, **Calculus**, Vol. III, S. Viswanathan Pvt. Ltd., (2004).
   UNIT I: Chapter 3: Sections 3.2, 3.3(Problems only) (Omit all theorems), 3.4 (Vol. I)[1],
   UNIT II: Chapter 5: Sections 5.4, 5.5 (Vol. I) [1],
   UNIT III: 1.1-1.3, 2.1, 2.4, 2.5, 3.7-3.3, 4 (Omit 2.2 and 2.3) [2], UNIT IV: 5.1, 5.3 and 6.1[2],
   UNIT V: Chapter 6: Sections 1 – 6 (Omit Charpit's Method) (Vol. II) [1].

Reference Book:

1. B. S. Grewal, **Higher Engineering Mathematics**, Khanna Publishers, 2014.
2. E. Kreyszig, **Advanced Engineering Mathematics**, Wiley, 2023.

I YEAR: SEMESTER – II

MIONR 2: MATHEMATICS FOR PHYSICS – II / MATHEMATICS FOR CHEMISTRY – II

(4 CREDITS) (60 HOURS)

Course Objectives:

1. To apply differential calculus to understand curvature and learn basic integrations.
2. To learn vector calculus using vector differentiation and integration.

UNIT I: DIFFERENTIAL CALCULUS

Polar coordinates – Angle between the radius vector and the tangent – Angle of intersection of two curves in polar coordinates – Curvature – Cartesian formula of Radius of Curvature – Radius of curvature in polar coordinates – p-r equation of a curve (except centre of curvature, evolutes and involutes).

UNIT II: INTEGRAL CALCULUS

Integration by parts – Properties of Definite Integrals – Reduction formula for $\int x^n e^{ax} dx$, $\int x^n cos\, ax\, dx$ and Reduction formula for $(i)\ \int sin^n x\, dx\ \ (ii)\ \int cos^n x\, dx\ \ (iii) \int sin^m x\, cos^n x\ dx$ (Simple Problems only).

UNIT III: VECTOR DIFFERENTIATION

Physical applications – Level surfaces – Vector Differential Operator – Gradient – Direction and Magnitude of Gradient – Directional Derivative – Divergence and Curl – Simple Problems.

UNIT IV: VECTOR INTEGRATION

Line Integral – Volume Integral – Surface Integral (Simple Problems only).

UNIT V: VECTOR INTEGRATION (Continued)

Green's Theorem in plane (Statement only) – Gauss Divergence Theorem (Statement only) – Stoke's Theorem (Statement only) – Simple Problems.

Textbook:

1. T.K. Manikavachagom Pillai, Narayan, R. Hanumantha Rao, Dr. P. Kandaswamy, **Allied Mathematics** course of B.Sc Physics and Chemistry (Vol. I and Vol. II), S. Viswanathan (Printers and Publishers) PVT limited, 2008.

   UNIT I: Chapter 6: Section 6.3 (Omit Slope of the tangent in polar coordinates, polar sub tangent and sub normal, the length of the arc in polar coordinates), (Vol. I).

   UNIT II: Chapter 1: Section 11, Section 13 – 13.1, 13.2, 13.3, 13.4, 13.5 (Except 13.6, 13.7, 13.8, 13.9, 12.10) (Vol. II), UNIT III, IV and V: Chapter 8: Sections 14 – 20, Chapter 8 : Sections 1 – 6, Section 9, Section 10 (Vol. II).

Reference Book:

1. B. S. Grewal, **Higher Engineering Mathematics**, Khanna Publishers, 2014.
2. E. Kreyszig, **Advanced Engineering Mathematics**, Wiley, 2023.

II YEAR: SEMESTER – III

MIONR 3 - MATHEMATICS FOR PHYSICS – III / MATHEMATICS FOR CHEMISTRY – III

(4 CREDITS) (60 HOURS)

Course Objectives:

1. To learn Laplace transform and to solve ordinary differential equations using Laplace transform.
2. To understand probability and statistics.

UNIT I: LAPLACE TRANSFORMS

Definition – Properties – Laplace transform of functions: 1, e^{at}, e^{-at}, $\cos at$, $\sin at$, $\cosh at$, $\sinh at$ and t^n, n is a positive integer – Simple Problems – Laplace transform of Derivatives (Upto Second Derivative) – Laplace transform of integrals.

UNIT II: INVERSE LAPLACE TRANSFORMS

Inverse Laplace transform – Solution of Ordinary Differential Equations using Laplace transform (Omit simultaneous and integral equation).

UNIT II: FOURIER SERIES

Fourier series definition – Finding Fourier coefficients for a given periodic function with period 2π – Odd and Even functions – Half-Range series – Development in Cosine series – Development in Sine series.

UNIT IV: PROBABILITY THEORY

Basic Terminology – Mathematical probability – Simple problems – Axiomatic approach to probability – Random experiment – Sample space and elementary events – Events – Acceptable assignment of probabilities – Axiomatic probability – Some theorems on probability – Addition theorem of probability – Conditional probability – Multiplication theorem of Probability – Independent Events – Bayes' theorem (Simple problems).

UNIT V: STATISTICS

Basics of Statistics – Correlation – Rank correlation – Regression analysis – Simple problems only.

Text books:

1. T.K. Manikavachagom Pillai, Narayan, R. Hanumantha Rao, Dr. P. Kandaswamy, **Allied Mathematics** course of B.Sc Physics and Chemistry (Vol. I and Vol. II), S. Viswanathan (Printers and Publishers) PVT limited, 2008.
2. S. C. Gupta and V. K. Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand and Sons, 2010.
   UNIT I and II: Chapter 7: Sections 1 – 6 [1],
   UNIT III: Chapter 2: Sections 1 – 5 (Omit Change of Interval and combination of series) [1],
   UNIT IV: 3.3, 3.4, 3.8, 3.8.1, 3.8.2, 3.8.3, 3.8.5, 3.9, 3.9.1, 3.10, 3.11, 3.12, 4.2 (Omit 3.8.4, 3.8.6, 3.9.2, 3.9.3, 3.13, 3.14, 4.2.1) [2]
   UNIT V: 10.2, 10.3, 10.4, 10.7, 11.1, 11.2, 11.2.1 (Omit 10.4.1, 11.2.2, 11.2.3, 11.2.4) [2].

Reference Book:

1. B. S. Grewal, **Higher Engineering Mathematics**, Khanna Publishers, 2014.
2. R. S. N. Pillai and V. Bagavathi, **Statistics**, S. Chand & company.

MINOR COURSE FOR B.Sc. COMPUTER SCIENCE, OFFERED BY DEPARTMENT OF MATHEMATICS

I YEAR: SEMESTER – I

MINOR – 1: MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE – 4 CREDITS (60 HOURS)

Course Objectives:

1. To learn about the basic mathematical concepts those are used in Computer Programming.

UNIT – I:

Matrices – Definition – Special types of matrices – Operations – Symmetric matrices – Skew symmetric matrices – Hermitian and skew Hermitian matrices – Inverse – Orthogonal matrices – Solution of Simultaneous equations – Ranks of a matrix – Eigenvalues and eigenvectors – Cayley – Hamilton Theorem.

UNIT – II:

Lattices: Lattices – Some properties – New Lattices – Modular and Distributive Lattices.

UNIT – III:

Boolean Algebra: Boolean Algebra – Boolean Polynomials – Karnaugh Map – Switching Circuits.

UNIT – IV:

Graph Theory: Basic Concepts – Incidence and Degree – Paths and Circuits – Subgraph – Connected graph Matrix Representation of Graphs.

UNIT – V:

Graph Theory: Trees – Properties of Trees – Spanning Trees – Kruskal's Algorithm – Prim's Algorithm.

Textbooks:

1. Dr. A. Singaravelu, **Allied Mathematics**, ARS Publication, Chennai, 2018.
2. T. Veerarajan, **Discrete Mathematics with Graph Theory and Combinatorics**, McGraw Hill education, 2017.

   UNIT I: Chapter2: 2.9 – 2.32, 2.44 – 2.52, 2.69 – 2.129, 2.132 – 2.151[1]

   UNIT II: Chapter 2: pages 67-102[2], UNIT III: Chapter 2: pages 103-139 [2]

   UNIT IV: Chapter 3: pages 366-387[2], UNIT V: Chapter 3: 387-417[2].

Reference Books

1. J. P. Trembly and R. Manohar, **Discrete Mathematical Structures with Applications to Computer Science**, TATA McGraw-Hill Edition, (2008).
2. S. Arumugam and S. Ramachandran, **Invitation to Graph Theory**, Scitech, (2015).

I YEAR: SEMESTER – II

MINOR 2: MATHEMATICS FOR DATA SCIENCE – 4 CREDITS (60 HOURS)

Course Objective:

1. To understand functions, its derivatives and maxima/minima of functions.
2. To approximate functions by polynomials.
3. To explore basic structure of vector spaces.

UNIT – I:

Functions, Derivatives of functions, convex functions, Maxima and minima of functions of one variable.

UNIT – II:

Functions of several variables, Partial derivatives of functions of several variables, Maxima and minima of two or three variable functions and Taylor's Series expansion with simple problems.

UNIT – III:

Polynomials, Interpolation, Newton's forward and backward interpolation, Lagrange's Interpolation.

UNIT – IV:

Vectors and Vector spaces, Vector subspaces.

UNIT – V:

Linear dependence and independence of vectors, Span, Basis of vector space.

Textbooks:

1. S. Narayanan, T. K. Manicavachagom Pillay, **Calculus** Vol. 1, S. Viswanathan Printers & Publishers Pvt. Ltd. Chennai, (2022)
2. I. N. Herstein, **Topics in Algebra** (Second Edition), Wiley Eastern Ltd., New Delhi, (1989).
3. S. S. Sastry, **Introductory methods of Numerical analysis**, Fifth edition, PHI Learning Private Limited, (2012).
4. James Stewart, **Calculus: Early Transcendentals**, Cengage India, 2016.

Reference Books

1. B. S. Grewal, **Higher Engineering Mathematics**, Khanna publishers, New Delhi, (2014).
2. K. Hoffman and R. Kunze, **Linear Algebra**, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, (1971).
3. Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathi, **Numerical Methods**, S. Chand., (2006).

II YEAR: SEMESTER – III

MINOR 3: PROBABILITY AND STATISTICS – 4 CREDITS (60 HOURS)

C**ourse Objective:**

1. To equip students with the skills to apply probability models, understand discrete and continuous distributions, and perform hypothesis testing for both large and small samples.
2. To foster the ability to solve complex combinational problems and compute expectations and variances, etc.

UNIT – I:

Introduction – Motivations – Probability Models – Sample Space – Events – Algebra of Events –Graphical Methods of representing events using the graph – Probability axioms – Combinational problems – Conditional probability – Independence of events – Bays rule – Bernoulli's trails.

UNIT – II:

Discrete random variable: Introduction – Random variables and their event spaces – The probability mass function – Distribution function – Special Discrete distributions: The Bernoulli PMF – Binomial, Geometric, Negative Binomial, Poisson, Hyper geometric and uniform PMF, Continuous random variable – Normal distribution.

UNIT – III:

Expectation: Introduction – Moments – Expectation of functions of more than one random variable.

UNIT – IV:

Types of hypotheses: Introduction – Procedure of testing hypothesis – Type 1 and Type 2 errors – Standard errors and sampling distribution – Test for significance for large samples – Test for single population mean, difference between two population means and difference between two standard deviations.

UNIT – V:

Test of significance for small samples – Students t distribution – Test the significance of the mean of random sample – Test for difference between the mean's (Independence samples – Dependent samples) – F test and analysis of variance – The F – test (or) variance ratio test – Applications of F test – Analysis of variance – Techniques of analysis of variance (one way and two-way classifications).

Textbooks:

1. S. C. Gupta and V. K. Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand and sons, New Delhi, 2002.

   UNIT I, II and III: 3.1-6.60, UNIT IV: 14.1-14.42, UNIT V: 16.1-16.60.

Reference Books

1. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, **An Introduction to Probability and Statistics**, Second edition, Wiley, 2011.

MINOR COURSE FOR B.Com. CORPORATE SECRETARYSHIP

OFFERED BY DEPARTMENT OF MATHEMATICS

II YEAR: SEMESTER – III
MINOR – 1: BUSINESS STATISTICS - I – 4 CREDITS (60 HOURS)

Course Objectives:

1. To expose the students to topics like frequency distribution and measures of central tendency, Measures of dispersion and skewness, correlation and regression, Index numbers and Interpolation and Extrapolation.

UNIT – I: FREQUENCY DISTRIBUTION AND MEASURES OF CENTRAL TENDENCY

Frequency distribution, Individual observation, Discrete (ungrouped) frequency distribution, Continuous or grouped frequency distribution – Two way frequency distribution (bi-variate) – Measures of central tendency (Averages).

UNIT – II: DISPERSION, SKEWNESS, KURTOSIS AND MOMENTS

Definitions, Concepts of variation, Purpose of measuring variation, Properties of a good measure of Variation, Methods of Measuring Dispersion, Range, Merits, Demerits, Uses of Range, Inter-Quartile Range and Quartile Deviation, Merits of Quartile Deviation, Demerits, Mean or Average Deviation, Coefficient of Mean Deviation, Computation of Mean Deviation, Mean Deviation Discrete Series, Short-cut method of Computing Mean Deviation, Mean Deviation – Continuous Series, Merits, Demerits, Uses, Standard Deviation, Calculation of Standard Deviation: Discrete Series Calculation of Standard Deviation – Continuous Series. Combined Standard Deviation, Merits, Demerits, Uses, Comparison between Mean Deviation and Standard Deviation, Coefficient of Variation (Quartile Standard Deviation). Meaning, Usefulness, Correlation and Skewness, Measures of Skewness, Objective, Karl Pearson's Coefficient of Skewness, Bowley's Coefficient of Skewness, Kelley's Coefficient of Skewness, Kurtosis, Measures, Moments.

UNIT – III:

CORRELATION AND REGRESSION:

Correlation – Definition of Correlation, Graphic and Mathematical, Scatter diagram, Simple graph, Coefficient of Correlation, Karl Pearson's Coefficient of Correlation, Assumptions, Merits and demerits, Mathematical properties, Interpreting the Coefficient of Correlation, Coefficient of Correlation and probable error, Rank correlation, Concurrent deviation.

REGRESSION:

Meaning, Definition, Uses, Significance, Correlation and Regression Method of Studying Regression, Graphic and Algebraic, Mathematical Properties.

UNIT – IV: INDEX NUMBERS:

Meaning, Definition, Characteristics Uses, Types, Problem of Construction of Index Numbers, Method, Simple Aggregate, Weighted Aggregate, Test of Consistency of Index numbers, Time Reversal test, Factor Reversal test, Unit Test, Circular Tests Chain-Base-Base Shifting – Splicing –Deflating consumer Price Index – Family Budget – Limitation of Index numbers – Formula – Theoretical questions, Practical problems.

UNIT – V: INTERPOLATION AND EXTRAPOLATION

Meaning, Uses, Assumptions, Methods of Interpolation, Graphic, Algebraic – Binomial Expansion Method, Newton's Method of Advancing Differences, Newton Gauss (Forward and Backward) Method, Newton's Method of Backward differences, Newton's Divided difference Method, Lagrange's Method.

Textbooks:

1. S. P. Gupta, **Statistical Methods**, S. Chand & Company, 2021.
2. R. S. N.Pillai and V. Bagavathi, **Statistics**, S. Chand & Company, 2008.

II YEAR: SEMESTER – IV
MINOR – 2: BUSINESS STATISTICS - I I – 4 CREDITS (60 HOURS)

Course Objectives:

1. In this course students are exposed to topics like Analysis of Times Series, Association of Attributes, Theory of Probability, Probability distribution and Statistical Quality Control.

UNIT – I: ANALYSIS OF TIMES SERIES

Meaning, Definition, Uses, Time Series Modes, Secular Trend, Seasonal Variation, Cyclical Variation, Irregular Variation, Preparation of Data for analysis, Measurement of Secular Trend, Graphic method, Semi-average method, Moving average method, Method of Least squares, Parabola Curve, Selecting the type of Trend, Choice Conversion, Shifting of Origin, Measurement of Seasonal Variation, Method of Simple Average, Ratio to Trend method, Ratio to Moving average method. Link Relative method, Miscellaneous illustrations. Theoretical questions, Practical problems.

UNIT – II: ASSOCIATION OF ATTRIBUTES (restricted to two variables)

Classification, Uses of Terms and Notation, Positive and negative classes, Number of classes, Relationship, Determination of Frequencies, Consistency of Data, Comparison of Observed and Expected Frequencies, Comparison of Proportions, Yule's Coefficient of Association, Yule's Coefficient of Colligation, Pearson's coefficient of Contingency, Theoretical questions, Practical problems.

UNIT – III: THEORY OF PROBABILITY:

Probability as a concept, the three approaches to defining probability addition and multiplication laws of probability, Conditional probability, Bayes' Theorem.

UNIT – IV: PROBABILITY DISTRIBUTION

Probability distribution as a concept, Binomial, Poisson and Normal distributions, their properties.

UNIT – V: STATISTICAL QUALITY CONTROL

Introduction – Control charts, Types of control charts, Setting up a Control procedure, X chart, R chart, Control chart for the standard deviation or -Chart, R chart Vs chart, Control chart for P (Fraction defective), Advantage and Limitations of Statistical Quality Control.

Textbooks:

1. S. P. Gupta, **Statistical Methods**, S. Chand & Company, 2021.
2. R. S. N.Pillai and V. Bagavathi, **Statistics**, S. Chand & Company, 2008.