PONDICHERRY UNIVERSITY

RAMANUJAN SCHOOL OF MATHEMATICAL SCIENCES

NEP CURRICULUM & SYLLABI

FOR THREE YEAR

B.Sc. MATHEMATICS

AFFILIATED COLLEGES

FROM THE ACADEMIC YEAR (2023-24 onwards)

PONDICHERRY UNIVERSITY

UG Degree (BS Honours) 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 Integrated UG (Honours/Honours with Research) with lateral entry– exit facility in all the years study.

1.2. Age Limit:

- As per UGC Norms.

2. SHORT-TITLES AND DEFINITIONS

Definitions

a) **"Credit**" One credit is equivalent to 15 hours of teaching (lecture or tutorial) or 30 hours of practical and/or field work or community engagement and service per semester.

b) "**Academic Year**" from June- May (2 semester).

c) "**Semester**" means 15-16 weeks of teaching-learning session of which two weeks shall be set apart for examination and evaluation;

d) **"Summer term"** is for 8 weeks during summer vacation. Internship/apprenticeship/work based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.

e) "**Grade**" means a letter grade assigned to a student in a Course for her/his 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, and F=0, Ab=0;

f) "**Semester Grade Point Average (SGPA)**" is computed from the grades as a measure of the students' performance in agiven semester.

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

2.1 Duration of the Programme

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.

2.2 Eligibility for the UG Programmes

Pass in +2 with a minimum of 50% of marks with Mathematics or equivalent stage of education to Level-4 (Levels in NHEQF).

3.0. 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 42 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 84 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.

3- 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 124 credits and satisfying the minimum credit requirements as mentioned in the table below.

4- year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree, earning a minimum of 164 credits and have satisfied the credit requirements as mentioned in table below.

4-year UG Degree (Honours with Research): Students who secure a 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. The research project/dissertation will be in the major discipline. The students who secure a minimum of 164 credits, including 12 credits from a research project, will be awarded UG Degree (Honours with Research).

4.0. STRUCTURE OF THE UNDERGRADUATE PROGRAMME

Table 1: Breakup of Credits and Courses- Minimumrequirement (Integrated Programme)

Sl. No.	Component	3 Year UG	4 Year UG (Honours/research)
1	Major Disciplinary/Interdisciplinary Courses	60 Credits (15 Courses of 4 credits)	80 Credits (20 Courses of 4credits)
2	Minor Disciplinary/interdisciplinary Courses (Vocational programme included)	24 Credits (6 Courses of 4 Credits)	32 Credits (8 Courses of 4credits)
3	Multi-Disciplinary Courses	9 Credits (3 courses of 3 credits)	9 Credits (3 courses of 3credits)
4	Ability Enhancement Courses	12 Credits (4 courses of 3 credits)	12 Credits (4 courses of 3credits)
5	Skill Enhancement Course	9 Credits (3 courses of 3 credits)	9 Credits (3courses of 3credits)
6	Value-added courses	8 Credits (4 courses of 2 credits)	8 Credits (4 courses of 2credits)
7	Summer internship	(4credits- Included in Major courses of 60 credits)	(4 credits-Included in Major courses of80 credits)
7	Community engagement and service	2 Credits (1 course)	2 Credits (1 course)
8	Research Dissertation Project	-	12 Credits
9	Total	124	164

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

4.1 STRUCTURE OF THE UNDERGRADUATE PROGRAMME in Mathematics UNDER NEP

Sem	Levels of Course in Major/Minor	Focus of Course Structure	Major Discipline	Minor Discipline	Multi-disciplinary Courses (MD)*	Ability Enhancement courses (AEC)	Skill Enhancement Courses (SEC)	Value-added courses (VAC)	Total
I	100-199 *Foundation/Introductory courses.*	*-should equip students to take up advanced courses/ specialized coursework,-to choose disciplinary/interdisciplinary course of their interest prospective professional field*	Major 1 (4Cr) (100 level)	Minor 1 (4 Cr) (100 level)	MD-1 (3 Cr) *(Can be chosen from bouquet)* *1.Natural/Physical Sciences* *2.Math/Stati/Comp.Applicatio* *3. Lib.Information and Media.Sciences.* *4.Commerce&Management* *5.Humanities&Social sci*	Eng -1 (3 Cr) *Linguistic/communication Skills/critical reading/academic writing/cultural intellectual heritage of language /abilities to discuss/ debate*	SEC-1 (3 Cr) *(Practical skills, Hands on, soft skills and so on for employability in the disciplinary/interdisciplinary areas chosen)*	VAC-1 (2cr) Understanding India VAC-2 (2cr) Environmental Science/Edn)- (2cr)	**21**
II			Major-2 (4Cr) (100 level)	Minor 2 (4 Cr) (100 level)	MD-2 (3cr) *(Can be chosen from above)*	MIL -1 (3cr) *(Can be chosen from above)*	SEC-2 (3cr) *(Practical skills, Hands on, soft skills and so on for employability)*	VAC-3 *(2cr) Health & Well Being / Yoga /sports/fitness* *VAC-4 (2cr) Digital Technologies*	**21**
Students exiting the programme after securing 40 credits will be awarded UG Certificate in Mathematics provided they secure 4 credits in workbased vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.									
III	200-299 :*Intermediate level courses*	*Prerequisite for advanced level major courses*	Major 3 Major 4 (8 cr) 200level	Minor 3 (4 Cr) 200 level (Vocational)	MD-3 *(3cr)* *(Can be chosen from above)*	Eng -2 (3cr) *(Can be chosen from above)/abilities to discuss/ debate*	SEC- 3 (3cr) *(Can be chosen from above)*		21
IV			Major 5-7 (12 cr) (200 level)	Minor 4 (4 Cr) (200&above) (Vocational)		*MIL -2 (3 Cr)* (as above)		*Community Engagement and Service(2cr)*	21
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.									

V	300-399: HigherLevel courses	*Disciplinary/interdisciplinary course study for the award of degree*	Major 8-10 (12 cr) (300 level)	Minor 5 (4 Cr) (200&above) (Vocational)			Internship(4cr) (Major 11)		20
VI			Major 12-15 (16 cr) 300 level	Minor 6 (4 Cr) (200&above))					20
❖ Students who want to undertake 3-year UG programme will be awarded UG Degree in Mathematics upon securing 122 credits. ❖ 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..									
VII	400-499: Advanced Courses	*Lectures with seminars/term papers/ /labs/hands on, internships, Research/projects and so on.* *(Research methodology/Statistics course for UG with Research)*	Major 16 Major 17 Major 18 (12 cr) (400 level)	Minor 7 Minor 8 (8 Cr) (300&above					20
VIII			Major 19 Major 20 (8 cr)(400level)			Research Project/Disssertation (12 Cr)			20
❖ Students will be awarded UG Degree (Honours) with Research in Mathematics provided they secure 164 credits ❖ Honours students not undertaking research will do 3 courses for 12 credits in lieu of a research project / Dissertation. Students of UG honours with research will choose a research component in the 4th year and complete research methodology courses and advanced courses in major/minor.									

4.2. Description of courses

(i) Major Discipline (60 to 80 Credits)

Major discipline is the discipline or subject of main focus and the degree will be awarded in that discipline. Students should secure the prescribed number of credits (not less than 50% of the total credits) through core courses in the major discipline. The major discipline would provide the opportunity for a student to pursue in-depth study of discipline. A student may choose to change the major discipline within the broad discipline at the end of the second semester provided all the prerequisites of the respective degree programme are fulfilled.

(ii) Minor Discipline (24 to 32 credits)

Minor discipline helps a student to gain a broader understanding beyond the major discipline. For example, if a student pursuing an Economics major obtains a minimum of 12 credits from a bunch of courses in Statistics, then the student will be awarded B.A. degree in Economics with a Minor in Statistics.

- *24 credits of minor courses in the 3-year programme can be Disciplinary or Interdisciplinary courses or a mix of both. 50% of the total credits from minors must be secured in the relevantsubject/discipline and another 50% of the total credits can befrom any discipline of students' choice.*
- 12 credits (50%) of the Minor (Disciplinary / Interdisciplinary) in the 3-year programme should be related to vocational education/training courses.

Type of Minor	Credits
Disciplinary/Interdisciplinary	12 cr
Disciplinary/Interdisciplinary vocational	12 cr

(iii) Multidisciplinary courses (MD): 9 credits

All UG students are required to undergo 3 introductory-level courses relating to any of the broad disciplines given below. These courses are designed and developed by every department for the benefit of other discipline students and are pooled by SAMS under 5 baskets for students to choose any 3 courses from 3 broader areas (one each from any three broad areas from below) from the basket. Studentsare not allowed to choose or repeat courses already undergone at the higher secondary level (12th class) under this category.

a. ***Natural and Physical Sciences:*** Students can choose basic courses from disciplines such as Natural Science, for example, Biology, Botany, Zoology, Biotechnology, Biochemistry, Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Sciences,

and other related subjects.

b. ***Mathematics, Statistics, and Computer Applications:*** Courses under this category will facilitate the students to use andapply tools and techniques in their major and minor disciplines. The course may include training in programming software like Python among others and applications software like STATA, SPSS, Tally and similar others. Basic courses under this category will be helpful for science and social science in data analysis and the application of quantitative tools.

c. **Library, Information, and Media Sciences:** Courses from this category will help the students to understand the recent developments in information and media science (journalism,mass media, and communication)

d. ***Commerce and Management:*** Courses include business management, accountancy, finance, financial institutions, fintech and other related subjects.

e. ***Humanities and Social Sciences:*** The courses relating to Social Sciences, for example, Anthropology, Communication and Media, Economics, History, Linguistics, Political Science, Psychology, Social Work, Sociology and other related subjects will enable students to understand the individuals and their social behaviour, society, and nation. Students be introduced to survey methodology and available large-scale databases for India. The list of Courses that can include interdisciplinary subjects such as Cognitive Science, Environmental Science, Gender Studies, Global Environment & Health, International Relations, Political Economy and Development, Sustainable Development, Women's and Gender Studies and similar subjects. will be useful to understand society.

(iv) Ability Enhancement Courses (AEC): 12 credits

Modern Indian Language (MIL) & English language focused on language and communication skills.

Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and acquaint with the cultural and intellectual heritage of languages.

(v) Skill Enhancement Courses (SEC): 9 credits

These courses are aimed at imparting practical skills, hands-on training, soft skills, and other skills to enhance the employability of students. The institution may design courses as per the students' needs and available institutional resources. Skill based courses could be related to disciplinary/interdisciplinary minors and vocational education programmes chosen/offered.

Value-Added Courses (VAC) Common to All UG Students: 8 credits

a) ***Understanding India:*** This course aims at enabling the students to acquire and demonstrate the knowledge and understanding of contemporary India with its historical perspective, the basic framework of the goals and policies of national development, and the constitutional obligationswith special emphasis on constitutional values and fundamental rights and duties. The course would also focus on developing an understanding among student- teachers of the Indian knowledge systems, the Indian education system, and the roles and obligations of teachers to the nation in general and to the school/community/society. The course will attempt to deepen knowledge about and understanding of India's freedom struggle and of the values and ideals that it represented to develop an appreciation of the contributions made by people of all sections and regions of the country, and help learners understand and cherish the values enshrined in the Indian Constitution and to prepare them for their roles and responsibilities as effective citizens of a democratic society.

b) ***Environmental Science/Education:*** This course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution,effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living. The course will also deepen the knowledge and understanding of India's environment in its totality, its interactive processes, and its effects on the future qualityof people's lives.

c) ***Digital and Technological Solutions***: Courses in cutting- edge areas that are fast gaining prominences, such as Artificial Intelligence (AI), 3-D machining, big data analysis, machine learning, drone technologies, and Deep learning with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

d) ***Health & Wellness, Yoga Education, Sports, and Fitness:*** Course components relating to health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person. Sports and fitness activities will be organized outside the regular institutional working hours. Yoga education would focus on preparing the students physically and mentally for the integration of their physical, mental, and spiritual faculties, and equipping them with basic knowledge about one's personality, maintaining self- discipline and self-control, to learn to handle oneself wellin all life situations.

(vi) Vocational Training/Education: 12 Credits

These courses are meant to provide the students with adequate knowledge and skills for employment and entrepreneurship. Departments are expected to incorporate the requirements of related industries while designing these courses to groom the students to take up gainful employment or becoming entrepreneurs. Vocational education courses designed by each department should relate the skills provided with the content of general education in order to ready the students for work at each exit point of the programme. A minimum of 12 credits will be allotted to the minor stream relating to vocational education and training.

(vii) summer Internship: 4Credits

- The Mathematics Departments have network with R&D Labs/PSUs/Govt. Departments/Academic Institutions for facilitating student internships.
- The transformed education should improve employability of students by providing internships/skill development.
- Opportunities for Internships with local industry, businesses, artists and craft persons to improve the employability of students.

All students will undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the summer term. Students will be provided with opportunities for internships to actively engage with the practical side of their learning and, as a by-product, further improve their employability.

(viii) Community Engagement and Service: 2 Credits

The curricular component of 'community engagement and service' seeks to expose students to the socio-economic issues in societyso that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course depending upon the major discipline. Community Engagement shall be conducted for a minimum of 2 weeks.

(ix) Research Project / Dissertation: 12 Credits

Students choosing a 4-Year Bachelor's degree (Honors with Research) are required to take up research projects under the guidance of a faculty member. The students are expected to complete the Research Project in the eighth semester.

(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.

4.3. Levels of the Courses

Courses can be coded based on the academic rigor. The first four letters of the course code indicate the department/Centre, followedby the academic rigor level code in digits (For e.g., Engl 201). The coding structure follows:

0-99: Pre-requisite courses required to undertake an introductory course which will be a pass or fail course with no credits. It will replace the existing informal way of offering bridge courses that are conducted in some of the colleges/ universities.

100-199: Foundation or introductory courses that are intended for students to gain an understanding and basic knowledge about the subjects and help decide the subject or discipline of interest. These courses generally would focus on foundational theories, concepts, perspectives, principles, methods, and procedures of critical thinking in order to provide a broad basis for taking up moreadvanced courses.

200-299: Intermediate-level courses including subject-specific courses intended to meet the credit requirements for minor or major areas of learning. These courses can be part of a major and can be pre-requisite courses for advanced-level major courses.

300-399: Higher-level Courses which are required for majoring in a disciplinary/interdisciplinary area of study for the award of a degree.

400-499: Advanced Courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year post-graduate theoretical and practical courses.

4.4 Credit-hours for different types of courses

A three-credit lecture course in a semester means three one-hour lectures per week with each one-hour lecture counted as one credit. One credit for tutorial work means one hour of engagement per week.

A one-credit course in practicum or lab work, community engagement and services, and fieldwork in a semester mean two- hour engagement per week. In a semester of 15 weeks duration, a one-credit practicum in a course is equivalent to 30 hours of engagement. A one-credit of Seminar or Internship or Studio activities or Field practice/projects or Community engagement and service means two-hour engagements per week. Accordingly, in a semester of

15 weeks duration, one credit in these courses is equivalent to 30 hours of engagement.

- ***Lecture courses:*** Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/vocation or professional practice
- ***Tutorial:*** Courses involving problem solving and discussions relating to a field or discipline.
- ***Seminar:*** A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation or professional practice.
- ***Internship:*** A course requiring students to participate in professional employment• related activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an employee of the given external entity.

 Laboratory work/activity: A course requiring students to discover/practice application of a scientific or technical principles/theories. The course may require scientific, or research focused experiential work where students observe, test, conduct experiment(s) or practice application of principles/theories relating to field of learning, work/vocation or professional practice.

- ***Studio activities:*** Studio activities involve engagement of students in creative or artistic activities. Studio-based activities involve visual- or aesthetic-focused experientialwork.
- ***Workshop-based activities:*** Courses involving workshop- based activities requiring engagement of students in hands- on activities related to work/vocation or professional practice.

 Field practice/projects: Courses requiring students to participate in field-based learning/project generally under the supervision of an employee of the given external entity.

5. Continuous Assessment and End semester Examination marks and evaluation of skill based/vocational courses/ Internships and other hands on/field-based courses

- All theory courses in a UG programme shall carry a continuous assessment component of 40 marks and end semester assessment component of 60 marks.
- In case of skill-based courses, vocational education courses, internships, practical, lab/field/project works, community service and related skill-based activities, the

evaluation pattern may be decided by the Programme Committee. The evaluation methods will be based on the learning outcomes planned for such courses following the NEP guidelines of Pondicherry University.

5.1 Continuous Assessment Component (Sessional)

- Evaluation will be based on continuous assessment carried out through activities spread over a complete semester based on the learning outcomes listed. Sessional work consists of class tests, at least one mid-semester examination, homework assignments, and any other innovative assessment methodology as determined by the faculty in charge of the course of study. Progress towards achievement of learning outcomes shall be assessed using the following: time-constrained examinations; closed-book and open-book tests; problem-based assignments; practical assignments; laboratory reports; observation of practical skills; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerized adaptive assessments, examination on demand, modular certifications and other suitable assessments methods.
- Total Marks from continuous assessments may be up to 40% of the total. Departments/Centres/Schools need to design suitable continuous assessment models splitting the 40 marks into 2 to 4 different components including at least one mid semester test, duly approved by the PC/BOS.

5.2 End- Semester Examination and Evaluation

5.2.1 End semester examinations shall be conducted for all courses offered in the department after ensuring that the required number of classes and related activities are completed. The duration of the end semester examination may be 3 hours.

5.2.2 A schedule of End semester examinations will be announced by the department about 15 days ahead of the conductof examinations.

5.2.3 The responsibility of question paper setting, invigilation and valuation of answer papers lie with the course teachers. However, all assessments shall be conducted under the uniform practices of the department approved in the programme committee.

5.2.4 However, the departments/faculty members are free to decide the components of continuous assessment and the method of assessment based on the nature of the course and are expected to communicate these to students and respective HODs at the beginning of the semester.

5.2.5 Mid semester /end semester examinations schedule notified by the University in the academic calendar shall be uniformly followed.

QUESTION PAPER PATTTERN: MAXIMUM MARK: 60 TIME : 3 HOURS

Number of Questions	Allocation of questions	Choice Type	Mark per question	Total marks
5	2 questions from each Unit	Either or type	12	**5X12=60**

5.3 Minimum Marks for Pass

A student shall be declared to have passed the course only if she/he gets,

5.3.1 A minimum of 40% marks in end semester exam and

5.3.2 A minimum of 50% marks in aggregate when continuous assessment and end semester examination marks are put together.

5.4 Supplementary examination

5.4.1 A student who gets F grade in a course shall be permitted to register for the supplementary examination in the following semester or in the subsequent semesters.

5.4.2 A student who gets F grade in a course shall be given an option either to retain the previously awarded continuous assessment mark or to improve it, and the higher mark out ofthese two options will be considered for the supplementary examination.

A student who gets Ab grade inacourse/practicum/vocational course/internship/practicum or any other hands-on skill related course is mandated to repeat the course and undergo all the stages of assessment in subsequent semesters.

5.5 Attendance Requirement

No student who has less than 70% attendance in any course shall be permitted to participate in end semester examination and she/heshall be given 'Ab' grade, -failure due to lack of attendance. she/he shall be required to repeat that course as and when it is offered.

6. LETTER GRADES AND GRADE POINTS

Performance of students in each paper will be expressed as marksas well as Letter Grades.

Letter Grade	Grade Point
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 case of fractions the marks shall be rounded off to nearest integer.The class interval K will be the formula given below: K = (X-50)/6, where X is the highest mark secured.

According to K value, one of the following grading scheme will befollowed.

6.1.1 If K ≥ 5, then the grades shall be awarded as given in Table II.

Table II		
Range of Marks in %	**Letter Grade Points for**	**Letter Grade Points for**
X to (X-K)+1	O	10
(X-K) to (X-2K)+1	A+	9
(X-2K) to (X-3K)+1	A	8
(X-3K) to (X-4K)+1	B+	7
(X-4K) to (X-5K)+1	B	6
(X-5K) to 50	C	5
40 – 49	P	4
Below 40	F	0
bsent (Lack of Attendance)	Ab	0

6.1.2 If K<5, then the grades shall be awarded as given in Table III.

Table III		
ange of Marks in %	**GradePoints for**	**Letter GradePoints for**
80-100	O	10
71-79	A+	9
66-70	A	8
61-65	B+	7
56-60	B	6
50-55	C	5
40-49	P	4
Below 40	F	0
ent (lack of attendance)	Ab	0

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.

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** (Si) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

(i) Example for Computation of SGPA where candidate has notfailed in any course.

ester	Course	redit	Letter Gr	Grade point	Credit Point (Credit xGrade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	B	6	4 X 6 = 24
		20			139
	SGPA				139/20=6.95

(ii) Example for Computation of SGPA where candidate has failedin one course.

nester	Course	redit	tterGrade	Grade point	Credit Point (Credit xGrade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			115
	SGPA				115/20=5.75

(iii) Example for Computation of SGPA where candidate has failed in two courses.

nester	Course	Credit	LetterGrade	Grade point	Credit Point (Credit xGrade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	F	0	3 X 0 = 00
I	Course 4	3	B	6	3 X 6 = 18
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			85
	SGPA				85/20=4.25

The CGPA shall also be calculated in similar way as shown in examples (i), (ii) and (iii) of SGPA for all subjects taken by the students in all the semesters. 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.

PONDICHERRY UNIVERSITY

Implementation of NEP in Affiliated Colleges NEP courses structure from the Academic Year 2023-24

Titles of the Degree Programme:

Bachelor of Sciences in Mathematics with Statistics(B.Sc., Mathematics with Statistics)

Titles of Diplomas embodied:UG Diploma in Mathematics (Dip. Mathematics)

Titles of Certificates embodied:UG Certificate of Mathematics

I.LIST OF MAJOR COURSES (Single Major)

Sl No	Nature of Course	Title of the Course(Single Major)	Credits	No. Hrs of Teacher
1.	Major 1	Calculus	4	5
2.	Major 2	Matrices and Theory of Equations	4	5
3.	Major 3	Real Analysis - I	4	5
4.	Major 4	Elements of Discrete Mathematics	4	5
5.	Major 5	Real Analysis - II	4	5
6.	Major 6	Group Theory	4	5
7.	Major 7	Elements of Differential Equations	4	5
8.	Major 8	Mathematical Modelling	4	5
9.	Major 9	Ring Theory	4	5
10.	Major 10	Complex Analysis-I	4	5
11.	Major 11	Programming Using SCILAB – Theory&Practical	4	5
12.	Major 12	Complex Analysis-II	4	5
13.	Major 13	Introduction to Linear Algebra	4	5
14.	Major 14	Graph Theory	4	5
15.	Major 15	Numerical MethodsUsing SCILAB – Theory&Practical	4	5

In case of Science courses the major courses 13, 14, 15 will be 6 lab session of 2 credits with 6 Hrs of work load

II. LIST OF MINOR COURSES (ELECTIVES/ALLIED/SPECIALISATION *

UG courses having different streams of specialisations may consider the minor stream Eg. B.Com(General), B.Com (Computer Science), b.Com (Foreign Trade), B.Com (Cooperative management), etc.

a) With Minor Stream I (Within the Department)

Sl No	Title of the Minor Course(Single Major)	Credits	No. Hrs of Teacher
Minor 1	Statistics-I	4	5
Minor 2	Statistics-II	4	5
Minor 3	Statistics-III	4	5
Minor 4	Statistics-IV	4	5
Minor 5	Operations Research - I	4	5
Minor 6	Operations Research - II	4	5

b) Minor Stream II (12 credits from the disciplines + 12 credits from discipline)

Sl No	Title of the Minor Course(Single Major)	Credits	No. Hrs of Teacher
Minor 1	Mathematics of Finance	4	5
Minor 2	Business Statistics	4	5
Minor 3	Numerical Analysis	4	5
Minor 4	Optimization Techniques-I	4	5
Minor 5	Optimization Techniques-II	4	5
Minor 6	Applied Statistics	4	5

c) Minor Stream III (All subjects are from other discipline)

Sl No	Title of the Minor Course(Single Major)	Credits	No. Hrs of Teacher
Minor 1	Matrices and Trigonometry	4	5
Minor 2	Calculus	4	5
Minor 3	Vector Calculus	4	5
Minor 4	Introduction to Differential Equations	4	5
Minor 5	Fourier Series and Laplace Transform	4	5
Minor 6	Numerical Analysis	4	5

III. MULTI DISCIPLINARY COURSES *

Sl No	Title	Credits	No. Hrs of Teacher
1.	Basics of Natural Science		
2.	Basics of Physical Sciences		
3.	Basics of Humanities & Social Sciences		

***** Common syllabus for all UG courses, Deans of respective schools will design the syllabus

IV. ABILITY ENHANCEMENT COURSES *

a) English

Sl No	Title UG BOS may choose one course for the given UG Degree	Credits	No. Hrs of Teach
1.	English Language & Literature	2	4
2.	Functional English	2	4
3.	Spoken English	2	4

b) Indian Language

Sl No	Title	Credits	No. Hrs of Teacher
1.	Literature & Language	2	4
2.	Functional English	2	4
3.	Spoken English	2	4

* All UG courses will have 4 credits of English and 4 credits of Indian Language

VI. SKILL ENHANCEMENT COURSES (ONLINE COURSES FROM SKILL INDIA)

Sl No		Title of the Skill/Vocational courses	Credits	No. Hrs of Teacher
	Skill 1	Quantitative Aptitude	3	4
	Skill 2	Logical Reasoning	3	4
	Skill 3	Latex	3	4

BOS identifies courses suitable to the students from Skill India courses offered by MOOCs/SWAYAM courses/Any other approved list of 3rd party certificate courses sponsored by Industry, GOI at special apprenticeship courses designed by any polytechnic college, Govt. MSME Training centres, BOS may also consider any other skill programmes that other Departments of the given institution. These may include skill training on computer programming, other emerging technologies.

VII. VALUE ADDED COMMON COURSES

Sl No		Title	Credits	No. Hrs of Teacher
	1.	Understanding India (1)		
	2.	Environmental Sciences/ Education (2)		
	3.	Health & Wellness / Yoga Education (3)		
	4.	Digital Technology Education (4)		

Common course structure and syllabus shall be prepared by:

Dean, School of Social Sciences for subject 1

Dean, Scholl of Life Sciences for subject 2

Dean, School of Computer Science for subject 4

Director, Directorate of Sports & Physical Education for subject 3

PONDICHERRY UNIVERSITY

RAMANUJAN SCHOOL OF MATHEMATICAL SCIENCES

DEPARTMENT OF MATHEMATICS

NEP CURRICULUM & SYLLABI

FOR THE

THREE YEAR B.Sc., MATHEMATICS WITH STATISTICS

OFFERED IN

AFFILIATED COLLEGES

PONDICHERRY UNIVERSITY

TO BE IMPLEMENTED WITH EFFECT FROM THE ACADEMIC YEAR (2023-24 onwards)

FIRST YEAR-SEMESTER I

Course Code	Type of Course	Credits	Hours	Title of the Course
MJD-1	Major Course 1	4	5	Calculus
MID-I	MinorCourse1	4	5	Statistics-I
MLDC-I	Multi–Disciplinary Course 1	3	4	
AEC-I	Ability Enhancement Courses 1	2	4	English-1 or Indian Language - 1
SEC-I	Skill Enhancement Courses 1	3	4	Quantitative Aptitude
VAC-I	Value-added Courses 1 & 2	2	4	Understanding India (Theory/Field based)
VAC-II		2	4	Environmental Sciences/ Education
Total Courses/ Credits/ Hours	7 Courses	20	30	

SEMESTER II

Course Code	Type of Course	Credits	Hours	Title of the Course
MJD-2	Major Course 2	4	5	Matrices and Theory of Equations
MID-II	MinorCourse2	4	5	Statistics-II
MLDC-II	Multi–DisciplinaryCourses2	3	4	
AEC-II	Ability Enhancement Courses 2	2	4	English-1 or Indian Language - 1
SEC-II	Skill Enhancement Courses 2	3	4	Logical Reasoning
VAC-III	Value-added Courses 3 & 4	2	4	Health, Wellness, Yoga Education, Sports & Fitness
VAC-IV		2	4	Digital Technology Education
Total Courses/ Credits/	7 Courses	20	30	

SECOND YEAR-SEMESTER III

Course Code	Type of Course	Credits	Hours	Title of the Course
MJD-3	Major Course 3	4	5	Real Analysis - I
MJD-4	Major Course 4	4	5	Elements of Discrete Mathematics
MID-III	MinorCourse3	4	5	Statistics - III
MLDC-III	Multi–Disciplinary Course 3	3	4	
AEC-III	Ability Enhancement Courses 3	2	4	English-2 or Indian Language - 2
SEC-III	Skill Enhancement Courses 3	3	4	Latex
Total Courses/ Credits/ Hours	6 Courses	20	27	

SEMESTER IV

Course Code	Type of Course	Credits	Hours	Title of the Course
MJD-5	MajorCourse5	4	5	Real Analysis - II
MJD-6	Major Course 6	4	5	Group Theory
MJD-7	Major Course 7	4	5	Elements of Differential Equations
MID-IV	MinorCourse4	4	5	Statistics - IV
AEC-IV	AbilityEnhancementCourses7&8	2	4	English-2 or Indian Language - 2
VAC-V	Community Engagement and Service	2	6	Community engagement NSS and other services
Total Courses/ Credits/ Hours	6 Courses	20	30	

THIRD YEAR-SEMESTER V

Course Code	Type of Course	Credits	Hours	Title of the Course
MJD-8	Major Course 8	4	5	Mathematical Modelling
MJD-9	Major Course 9	4	5	Ring Theory
MJD-10	Major Course 10	4	5	Complex Analysis- I
MID-11	Major Course 11	4	5	Programming Using SCILAB – Theory&Practical
MID-V	MinorCourse5	4	5	Operations Research - I
Total Courses/ Credits/ Hours	5 Courses	20	25	

SEMESTER VI

Course Code	Type of Course	Credits	Hours	Title of the Course
MJD-12	MajorCourse12	4	5	Graph Theory
MJD-13	Major Course 13	4	5	Introduction to Linear Algebra
MJD-14	Major Course 14	4	5	Complex Analysis- II
MJD-15	Major Course 15	4	5	Numerical Methods Using SCILAB – Theory& Practical
MID-VI	MinorCourse6	4	5	Operations Research - II
Total Courses/ Credits/ Hours	5 Courses	20	25	

II. LIST OF MINOR COURSES (ELECTIVES/ALLIED/SPECIALISATION)

These courses are designed for students from Physics, Chemistry, Biology, Computer Science, B.Com (General), B.Com (CS), etc. These courses will be floated depending on the number of students registering and the availability on the faculty. The number students may be restricted depending on the available classroom facility and first-cum-first serve basis.

a) With Minor Stream I (Within the Department)

Course Code	Type of Course	Credits	Hours	Title of the Course
MID-I	Minor Course 1	4	5	Statistics-I
MID-II	Minor Course 2	4	5	Statistics-II
MID-III	Minor Course 3	4	5	Statistics-III
MID-IV	Minor Course 4	4	5	Statistics-IV
MID-V	Minor Course 5	4	5	Operations Research-I
MID-VI	Minor Course 6	4	5	Operations Research-II

b) With Minor Stream II (12 credits from the disciplines +12 credits from discipline)

Course Code	Type of Course	Credits	Hours	Title of the Course
MID-I	Minor Course 1	4	5	Mathematics of Finance
MID-II	Minor Course 2	4	5	Business Statistics
MID-III	Minor Course 3	4	5	Numerical Analysis
MID-IV	Minor Course 4	4	5	Optimization Techniques I
MID-V	Minor Course 5	4	5	Optimization Techniques II
MID-VI	Minor Course 6	4	5	Applied Statistics

c) With Minor Stream III (All subjects are from other discipline)

Course Code	Type of Course	Credits	Hours	Title of the Course
MID-I	Minor Course 1	4	5	Matrices and Trigonometry
MID-II	Minor Course 2	4	5	Calculus
MID-III	Minor Course 3	4	5	Vector Calculus
MID-IV	Minor Course 4	4	5	Introduction to Differential Equations
MID-V	Minor Course 5	4	5	Fourier Series and Laplace Transforms
MID-VI	Minor Course 6	4	5	Numerical Analysis

VI. Skill Enhancement Courses (Online Courses from Skill India)

Course Code	Offered in Semester	NEP Classification	Credits	Hours	Title of the Course
SEC-I	I	Skill 1	3	4	Quantitative Aptitude
SEC-II	II	Skill 2	3	4	Logical Reasoning
SEC-III	III	Skill 3	3	5	Latex

VII. Multi-Disciplinary Course (All subjects are from other discipline)

Course Code	Offered in Semester	NEP Classification	Credits	Hours	Title of the Course
MLDC-I			3	4	Basic Mathematics

QUESTION PAPER PATTTERN

MAXIMUM MARK: 75

TIME : 3 HOURS

SECTION A	SECTION B
FIVE QUESTIONS (5X5 = 25) Either Or Type Internal Choice 1 set of questions from each Unit.	**FIVE QUESTIONS** (5X10 = 50) 5 out of 8 questions 1 question from each Unit compulsory.

Section	Number of Questions	Allocation of questions	Choice Type	Mark per question	Total marks
A	5	1 set from each Unit	Either or type	5	**5X5=25**
B	5	2 questions from Unit 1 2 questions from Unit 2 2 questions from Unit 3 1 question from Unit 4 1 question from Unit 5	5 out of 8	10	**5X10=50**

LIST OF MAJOR COURSES (SINGLE MAJOR)

I YEAR : SEMESTER – I
MAJOR - 1 : CALCULUS – 4 CREDITS (60 HOURS)

UNIT I :
nth derivative – Standard results – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula

UNIT II :
Total differential coefficients – Euler's theorem – Partial derivatives of a function of two functions - 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 – 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)

Prescribed Text(specify sections clearly)
Calculus Volume — I, T. K. Manickavachagom Pillai, Printers and Publishers (May1992 Edition)
Unit 1: Chapter 3 – 1.1, 1.2, 1.3, 1.4,1.5, 1.6, 2.1,
Unit 2: Chapter 8-1.3, 1.4, 1.5, 1.6, 1.7, 4, 4.1, 5,
Unit 3: Chapter 10 – 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5

Calculus Volume II , S.Narayanan and T.K. Manickavasagam Pillai (2008)
Unit 4 : Chapter 1 : 7.3, 7.4, 7.5, 8, 11
Unit 5 : Chapter 1: 12,13,14, 15.1, and Chapter 5: 2, 4,

Reference books
1. Integral Calculus, N. P. Bali, Laxmi Publications, Delhi, (1991)
2. 2. Calculus(2nd Edition), Lipman Bers and Frank Karal, Holt McDougal, 1976.
3. Thomas' Calculus 12th Edition, George B.Thomas, Maurice D.Weir and Joel Hass, Pearson Education, 2015.

I – YEAR : SEMESTER - II

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

Course Objectives:

1. To introduce the idea of matrices and to learn about the algebra of matrices
2. To solve system linear equations using matrix Theory

	Course Outcome
CO 1	To learn the relation between the co-efficient and roots of polynomial equations.
CO 2	To learn various methods for solving polynomial equations and study the nature & position of roots.
CO 3	Analytic Methods for solving the polynomial equation of degrees 3 & 4.

Unit I: (Section 1.1, 1.2, 1.3,1.4,1.5 of [1])

Linear systems - Matrices - Dot product and Matrix multiplication - Properties of Matrix operation, Matrix transformations.

Unit II: (Section 1.6,1.7,1.8[1])

Solutions of Linear systems of equations - Row echelon from reduced row echelon form – Polynomial interpolation - The inverse of a Matrix. - Linear Systems and inverses - LU- Factorization Method.

Unit III: (Sections 5.1,5-2,.5.3 of [2])

Division algorithm - Relation between roots and coefficients - Sum of the powers of the roots.

Unit IV: (section 5.4,5.5,5.6 ,5.7 of [2])

Reciprocal equations - Transformation of equations: - Multiple roots - Nature of position of roots - Sturm's Theorem.

Unit V: (5.8,5.9,5.10 of [2])

Cardan's Method for solving Cubic equations – Ferrari's Method for solving biquadratic equations - New Newton's Method- Horner's Method

Text Books

1. Bernard Kolman Drid R. Hill, Introductory Linear Algebra, (8e),Pea rson India (2011)
2. S. Arumugam and A Thangaand Isaac, Set Theory Number System and Theory of Equations, New Gamma publishing house(1997.).

References:

1. Theory of Equations, Hari Kishan, Atlantic Publishers, 2022

2.Theory of Equations, Lalji Prasad, New Revised Edition, 2016

II YEAR : SEMESTER - III

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

UNIT I :

Sets and elements — Operations on sets — Functions - Real valued functions - Equivalence — Countability — Real numbers — Least upperbound — 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 5under 4.2 c 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

Prescribed Text

Methods of Real Analysis, Treatment as inRichard R. Goldberg(1970)
Unit 1 : Chapter 1
Unit 2, 3: Chapter 2 and Chapter 3 (up to 3.8)
Unit 4 : Chapter 4
Unit 5 : Chapter 5

ReferenceBooks

1. *A First Course in Mathematical Analysis- D somasundaram& BChoudhyri- Narosa Publishing house New Dehli*
2. *Introduction to Calculus and Analysis, Vol.I, Richard Courant andFritz John, Springer 1999.*
3. *Introduction to Real Analysis, 4th Edition,Robert G.Bartle andDonald R.Sherbert, Wiley-2014.*

e-LearningSource :
http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org

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

Course Objectives:

1. Able to understand the concepts of sets and determine whether a relation is a function and identify the domain and range of a function.
2. Understand the ideas of the basis step and the inductive step in a proof by Mathematical induction and recurrence relations

	Course Outcome
CO 1	To understand the basic concepts of Permutations and combinatorics
CO 2	To familiarize the applications of Difference sequences and Catalan numbers.
CO 3	To understand the concepts and significance of lattices and Partition of numbers.

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:

Catalan numbers – Difference sequences - stirling numbers of the first kind and second kind.

Unit -V:

Partition of numbers – Ferrers diagram – A geometric application – Lattice Paths – Schroder numbers.

Text Books

1. **Edgar G. Goodaire, Michael M. Parmenter , Discrete Mathematics with Graph Theory (Third Edition), PHI Learning Private Ltd., New Delhi – 2011.**
2. **Richard A. Brualdi, Introductory Combinatorics, (Fourth Edition), Pearson Education 2004.**

Reference Books

1. Richard Johnsonbauth, Discrete Mathematics – 5th Edition,–, Pearson Education Asia, New Delhi, 2002.
2. Ralph. R. Grimaldi - Discrete and Combinatorial Mathematics: An applied Introduction – 4th Edition, Pearson Education Asia, Delhi, 2002
3. C.L. Lie, Elements of Discrete Mathematics — the Mc Graw-Hill, Inc. India 1985.
4. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, Discrete Mathematical Structure, 4th Edition print Pearson Education Pvt. Ltd., New Delhi 2003

II - YEAR : SEMESTER - IV

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

UNIT I:

More about 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.

Prescribed Text

Methods of Real Analysis, Treatment as in Richard R. Goldberg, (1970)

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. First Course in Mathematical Analysis by Dr.Somasundaram& B Choudhyri- Narosa Publishing house New Dehli

2. Real Analysis- byShanti Narayanan

e-Learning Source

http://ndl.iitkgp.ac.in

http://ocw.mit.edu

http://mathforum.org

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 **(12 hours)**

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

Unit II **(12 hours)**

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

Unit III **(12 hours)**

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

Unit IV **(12 hours)**

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 **(12 hours)**

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

Text Book:

Joseph A. Gallian, Contemporary Abstract Algebra, 8th Edition, Cengage Learning India Private Limited Chapter 2 to Chapter 12

Reference books

1 M. Artin: Algebra, Prentice-Hall of India, 1991.

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

MAJOR – 7 : ELEMENTS OF 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 understand solving the first and second order ODES and first order PDEs.

	Course Outcome
CO 1	To solve a system of first order ODEs
CO 2	To analyze the stability of a Dynamical System using Differential Equations and their solutions
CO 3	To Solve First Order Partial Differential Equations

Unit I:

Exact differential equations- Integrating factors – Linear differential equations- Bernoulli equation – Modeling: Electric circuits – Orthogonal trajectories of curves.

Unit II:

Homogeneous linear equations of second order – Second order homogeneous equations with constant coefficients – Case of complex roots- Complex exponential function – Differential operators – Modeling: Free oscillations – Euler-Cauchy equation – Existence and uniqueness theory – Wronskian.

Unit III:

Non homogeneous equations – Solution by undetermined coefficients – Solution by variation of parameters – Modeling of electric circuits – Higher order linear differential equations – Higher order homogeneous equations with constant coefficients.

Unit IV:

Introduction: vectors, matrices, eigenvalues – Introductory examples – Basic concepts and theory – Homogeneous systems with constant coefficients, phase plane, critical points – Criteria for critical points, Stability.

Unit V:

Non-linear first order PDEs : Compatible systems- Solutions of Quasi linear equations
Charpit's method- Special Types of Charpits Method, -Integral surfaces through a given curve-The Cauchy problem for Quasi Linear case and nonlinear first order PDEs

Text Book

Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, 1999.
Unit-I: Sections 1.5-1.8;
Unit-II: Sections 2.1-2.7;
Unit-III: Sections 2.8-2.10, 2.13, 2.14;
Unit-IV: Sections 3.0-3.4;
K. Shankara Rao, Introduction to Partial Differential Equations, PHI Publications, 3rd Edition. 2011. – Chapter 1

Reference Books

1. George F. Simmons, Differential Equations, Tata McGraw-Hill, New Delhi, 1972.
2. Boyce and Di Prima, Differential Equations and Boundary Value Problems, Wiley,10th edition 2012.
3. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall of India Private Ltd, 1991.

III – YEAR : SEMESTER - V

MAJOR – 8 : MATHEMATICAL MODELING – 4 CREDITS (60 HOURS)

Course Description: This course introduces undergraduate students to the fundamentals of mathematical modeling and its applications. Students will learn to formulate, analyze, and solve real-world problems using mathematical techniques covered in the textbook.

Course Objectives: By the end of the course, students should be able to:

1. Understand the modeling process and its importance in various disciplines.
2. Formulate mathematical models for real-world problems using difference equations, proportionality, and geometric similarity.
3. Fit models to data and make data-driven decisions.
4. Conduct experimental modeling and choose appropriate models for given data.
5. Perform simulation modeling to analyze deterministic and probabilistic behavior.

Unit 1: Modeling Change with Difference Equations

Introduction to Mathematical Modeling, Modeling Change with Difference Equations, Approximating Change with Difference Equations, Solutions to Dynamical Systems, Systems of Difference Equations

Unit 2: Proportionality and Geometric Similarity

Introduction to Proportionality and Geometric Similarity, Mathematical Models, Modeling Using Proportionality, Modeling Using Geometric Similarity, Automobile Gasoline Mileage, Body Weight and Height, Strength and Agility

Unit 3: Model Fitting and Data Analysis

Introduction to Model Fitting, Fitting Models to Data Graphically, Analytic Methods of Model Fitting, Applying the Least-Squares Criterion, Choosing a Best Model

Unit 4: Experimental Modeling

Introduction to Experimental Modeling, Harvesting in the Chesapeake Bay and Other One-Term Models, High-Order Polynomial Models, Smoothing: Low-Order Polynomial Models, Cubic Spline Models

Unit 5: Simulation Modeling

Introduction to Simulation Modeling, Simulating Deterministic Behavior: Area Under a Curve, Generating Random Numbers, Simulating Probabilistic Behavior, Inventory Model: Gasoline and Consumer Demand, Queuing Models

Text Book: A First Course in Mathematical Modeling, by Frank R. Giordano, Maurice D. Weir, and William P. Fox

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

Unit I **(12 hours)**

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 **(12 hours)**

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

Unit III **(12 hours)**

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

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

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

Text Book:

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

Chapter 12 to Chapter 18

Reference books

1 M. Artin: Algebra, Prentice-Hall of India, 1991.

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

3. David S. Dummit and Richard M. Foote, Abstract Algebra (Third Edition), John Wiley and sons, 2004

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

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 - heorems 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 & 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 $W = z + 1/z$.

Prescribed Text(specify sections clearly)
Complex Variables and Applications, James Ward Brown and Ruel V Churchill,McGraw - Hill, International Edition (2009)
UNIT I - chapter 1UNIT II - chapter 2 UNIT III - chapter 2UNIT IV - chapter 3UNIT V - chapter 4

ReferenceBooks

1. *Functions of a Complex variable by B. S. Tyagi – KedarNath RamNathPublishers(P) Ltd.*
2. *Complex Analysis by P. Duraipandian and KayalalPachaiappa –S.Chand& Co.*
3. *S. Ponnusamy, Foundations of Complex analysis, (2nd Edition), Narosa, 2011.*

V.Karunakaran, Complex Analysis, (2nd Edition), Narosa 2005

e-LearningSource
http://ndl.iitkgp.ac.in

MAJOR – 11 : PROGRAMMING USING SCILAB – THEORY & PRACTICAL - 4 CREDITS (60 HOURS)

UNIT I:

Overview of Scilab - How to get started with Scilab - Getting help from Scilab demonstrations and macros – The Console – The Editor – Batch Processing Creating Real Variables - Elementary mathematical functions – Booleans – Complex Numbers – Integrers – Floating Points – Strings – Dynamic Variables

UNIT II:

Matrices – Create Matrices of Real Variables – Accessing Elements of Matirces - Matrices are dynamic – Elementwise Operations Conjugate transpose and non-conjugate transpose - Multiplication of two vectors Comparing two real matrices - Issues with floating point integers - More on elementary functions - Higher-level linear algebra features

UNIT III:

Looping and branching - The if , select , for and while statements The break and continue statements Functions - Function libraries - Managing output arguments Levels in the call stack - The return statement - Debugging functions with pause

UNIT IV:

Plotting - 2D plot - Contour plots - Titles, axes and legends - Export

UNIT V:

Solving Ordinary Differential Equations using Scilab

Prescribed Text(specify sections clearly)

1. *Introduction to Scilab - Michael Baudin From Scilab Consortiun, 2010Chapters 1 to 8 (Book Freely Downloadable in Internet)*
2. *Plotting Using Scilab – An open Source Document – www.openeering.com*

ReferenceBooks

1. *Modeling and Simulation in Scilab, Stephen L. Campbell, Jean-PhilippeChancelier and Ramine Nikoukhah*
2. *An Introduction to Scilab from a Matlab User's Point of View by EikeRietsch*

e-LearningSource

http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org

III – YEAR : SEMESTER - VI

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

Course Objectives:

1. To introduce the notion of graphs and the basic terminologies in graphs
2. To learn the concept of spanning trees, Cayley's formula and to introduce the concept of connectivity and edge connectivity of 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 Book:-

1. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory (Universitext), 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. Bondy, J.A and Murthy, U.S.R, Graph Theory with Applications, Macmillan Press Ltd, New Delhi – (1976).Douglas B. West, Introduction to Graph Theory, Second Edition, PHI Learning Private Ltd, New Delhi-2011.
2. G. Chartrand, Linda Lesniak and Ping Zhang, Graphs and Digraphs, Fifth Edition, CRC press 2011.

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

Course Objectives:

1. To understand vector spaces by its definition and examples.
2. To know how to represent a linear transformation by a matrix

	Course Outcome
CO 1	To learn elementary operations on Matrices and how to apply them to find the solutions of a system of equations
CO 2	To learn the properties of determinant of matrices
CO 3	To know about inner products and orthogonalization

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- propertie4s 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

Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence, Linear Algebra, 4th Edition, Printice 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. S. Kumaresan, Linear Algebra Geometric Approach, Prentice Hall of India Pvt. Ltd., 2000.
2. I. N. Herstein, Topics in Algebra, 2nd Edition, John Wiley & Sons, 2003.
3. David C. Lay, Linear Algebra and Applications (2nd Edition), Addison Wesley, 1997.
4. John B. Fraleigh, A First Course in Abstract algebra, (7th Edition), Pearson 2013.

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

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 - Taylor series -Observations and examples – Laurent Series (statement only).

UNIT IV:
Singularities - Definitions and examples - Residues - The residue theorem - The principal part of a function - Residues andpoles – zeros and poles of order m.

UNIT V:

$$Type\ 1: \int_{-\infty}^{\infty} \frac{p(x)}{q(x)}\,dx$$

$$Type\ 2: \int_{-\infty}^{\infty} \frac{p(x)}{q(x)} \sin ax\,dx\ (or) \int_{-\infty}^{\infty} \frac{p(x)}{q(x)} \cos ax\,dx$$

$$Type\ 3: \int_{0}^{2\pi} F(\sin\theta, \cos\theta)\,d\theta$$

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

Prescribed Text(specify sections clearly)
Complex Variables and Applications, James Ward Brown and Ruel VChurchill, 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

ReferenceBooks

1. *Functions of a Complex variable by B. S. Tyagi – KedarNath RamNathPublishers(P) Ltd.*
2. *Complex Analysis by P. Duraipandian and KayalalPachaiappa –S.Chand& Co.*
3. *S. Ponnusamy, Foundations of Complex analysis, (2nd Edition), Narosa,2011.*
   V.Karunakaran, Complex Analysis, (2nd Edition), Narosa 2005

e-LearningSource
http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org

MAJOR – 15: NUMERICAL METHODS USING SCILAB THEORY & PRACTICAL

– 4 CREDITS (60 HOURS)

UNIT I:

Numerical solution of algebraic and transcendental equations – Bolzano's bisection method - Successive approximation method – Regula falsi method – Newton-Raphson method.

UNIT II:

Numerical solution of simultaneous linear algebraic equations – Gauss elimination method - Gauss Jordan elimination method – Gauss Seidel iteration method.

UNIT III:

Finite difference operator - Interpolation – Newton-Gregory forward and backward interpolation – Newton's divided difference formula – Lagrange's interpolation formula for uneven intervals – Gauss interpolation formula – Numerical differentiation – Numerical Integration – Trapezoidal rule – Simpson's 1/3rd rule.

UNIT IV:

Numerical solutions of Ordinary differential equations of first and second order – Simultaneous equations – Taylor series method – Picard's method.

UNIT V:

Euler's method – Improved Euler's Method - Modified Euler's Method – Runge-Kutta method of second and fourth order – Milne's predictor corrector method.

Text book

Numerical Method in Science and Engineering, M.K.Venkataraman,National Publication Co, Chennai(2001)
Unit 1: Chapter 3 and 4
Unit 2: Chapter 5
Unit 3: Chapter 6 and 9
Unit 4: Chapter 11 (Relevant portions)Unit 5: Chapter11 (Relevant portions)

ReferenceBooks

Computer oriented Numerical Methods by V. Rajaram – PHI(P) Ltd.

e-LearningSource

http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org

MINOR STREAM - I

MINOR – 1 : STATISTICS-I – 4 CREDITS (60 HOURS)

Course Objectives

* To introduce the basic concepts of probability and statistics, including sample spaces, events, probability rules, random variables, and probability distributions.
* To develop an understanding of the mathematical foundations of probability and statistics, such as expectation, variance, and covariance.
* To apply probability and statistics to solve problems in a variety of contexts, such as business, engineering, and science.

Unit I: (Chapter 3 – 3.1, 3.2, 3.3, 3.4, 3.5, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13)

Theory of Probability - I – Mathematical and Statistical Probability, Axiomatic approach to Probability – Some theorems on probability– Simple problems

Unit II: (Chapter 4 – 4.1, 4.2, 4.3)

Theory of Probability – II : Extended axiom of addition and axiom of continuity – Bayes' theorem – Geometric probability - Simple problems.

Unit III: (Chapter 5 – 5.1, 5.2, 5.3, 5.4, 5.5)

Distribution function – Discrete random variable – Continuous random variable – Two dimensional random variable – Simple problems.

Unit IV: (Chapter 6 - 6.1, 6.2, 6.3, 6.4, 6.5, 6.6)

Mathematical Expectation : Mathematical expectation or expected value of a random variable – expected value of function of a random variable – Properties of expectation – Properties of variance – Covariance – Simple problems.

Unit V: (Chapter 8 – 8.1, 8.2, 8.3, 8.4, 8.5, 8.7)

Special Discrete Probability Distributions : Discrete uniform distribution – Bernoulli distribution – Binomial distribution – Poisson distribution – Geometric distribution -

Text Book: S.C. Gupta & V.K. Kapoor , Fundamentals of Mathematical Statistics- Sultan Chand and Sons,12th Edition ,2022

Reference Books:

1. S.P. Gupta, Statistical methods- Sultan Chand and Sons, 45th Edition 2017

2. R.S.N.Pillai & V. Bagavathi, Statistics –S.Chand & company LTD, Reprint 2014

MINOR -2 : STATISTICS-II – 4 CREDITS (60 HOURS)

Course Objectives

- To introduce the normal distribution and its properties.
- To develop an understanding of the special continuous probability distributions.
- To introduce the concept of correlation and its measurement.
- To develop an understanding of the linear and curvilinear regression models.
- To introduce the concepts of theory of attributes and its applications.

Unit I: (Chapter 9 – 9.1, 9.2, 9.2.1, 9.2.2, 9.2.3, 9.2.5, 9.2.6, 9.2.7)

Normal Distribution: Limiting form of binomial distribution – Characteristics – Mode – Median – Moment Generating function – Cumulant Generating Function – Moments of Normal distribution

Unit – II: (Chapter 9 – 9.3, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.4, 9.5, 9.5.1, 9.5.2, 9.5.3)

Special Continuous Probability Distributions: Rectangular Distribution - Triangular distribution – Gamma Distribution – simple problems.

Unit III: (Chapter 10 – 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7)

Correlation: Meaning of correlation – scatter diagram – Karl pearson's coefficient of correlation – Calculation of the correlation coefficient for a bivariate frequency distribution – Probable error of correlation coefficient – Rank correlation – Simple problems.

Unit IV: (Chapter 11 – 11.4)

Linear and Curvilinear Regression : Linear regression – Curvilinear regression - Regression curves – simple problems

Unit V: (Chapter 13 – 13.13.7)

Theory of Attributes: Notations – Dichotomy – Classes and Class frequencies – Consistency of data – Independence of attributes – Association of attributes - Simple problems.

Text Book: S.C. Gupta & V.K. Kapoor , Fundamentals of Mathematical Statistics- Sultan Chand and Sons,11th Edition ,2014

Reference Books:

1. S.P. Gupta, Statistical methods- Sultan Chand and Sons, 45th Edition 2017

2. R.S.N.Pillai & V. Bagavathi, Statistics –S.Chand & company LTD, Reprint 2014

MINOR -3 : STATISTICS-III – 4 CREDITS (60 HOURS)

Course Objectives

- To introduce the concepts of sampling distribution and estimation.
- To develop an understanding of the different types of sampling methods and their errors.
- To learn how to construct and interpret confidence intervals for population means and proportions.
- To learn how to test hypotheses about population means and proportions using large and small sample theory.
- To introduce the concepts of experimental design and its applications.

Unit I: (Chapter 2 – 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8)

Sampling Distribution and Estimation: Introduction – types of sampling methods – sampling and non sampling errors – sampling distribution of mean , difference between two means, proportion, difference between two proportions – Central limit theorem – simple problems

Unit II: (Chapter 2 – 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.16)

Sampling Distribution and Estimation: Estimation – confidence interval for the population mean for large samples (when σ is known) , for small samples (when σ is unknown) – for the difference between two population means for large samples (when σ is known) , for the difference between two population means for small samples (when σ is unknown) – confidence interval for the difference between two population proportions for large samples – determining the sample size(using confidence interval)

Unit III: (Chapter 3 – 3.1, 3.2, 3.3, 3.4, 3.5, 3.6)

Tests of Hypothesis: test of significance for large sampling theory – Testing of hypothesis about a population proportion – about the difference between two proportions – about population mean – about difference between two means – difference between two standard deviations

Unit IV: (Chapter 3 – 3.7, 3.8, 3.9, 3.10, 3.11)

Tests of Hypothesis: Test of significance for small sampling theory – about the mean population – about the difference between two means(Using t – test) – Paired t – test for difference of means – testing of hypothesis for equality of two variances

Unit V: (Chapter 3 – 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19)

Tests of Hypothesis: Chi- square distribution - χ^2 Test of Goodness of Fit - χ^2 test of independence of attributes - χ^2 test for population variance – designs of experiments – Completely Randomized (CRD) or One-way Classification – Randomised block design (RBD) or Two way classification – Latin square design (LSD)

Text Book: K. Subramani & A. Santha, Statistics for Management, Second Edition 2011

Reference Books:

1. S.C. Gupta & V.K. Kapoor , Fundamentals of Mathematical Statistics- Sultan Chand and Sons,11th Edition ,2014

2. R.S.N.Pillai & V. Bagavathi, Statistics –S.Chand & company LTD, Reprint 2014

MINOR -4 : STATISTICS-IV – 4 CREDITS (60 HOURS)

Course Objectives

- To introduce the F-test and its applications.
- To develop an understanding of the Analysis of Variance (ANOVA) technique and its applications.
- To introduce the concepts of statistical quality control and total quality management.
- To develop an understanding of the methods of measuring fertility and mortality, and to learn how to construct life tables.
- To introduce the concepts of time series analysis and index numbers, and to learn how to construct and interpret these measures.

Unit I: (Chapter 5)

F – Test and Analysis of variance: The F- test or the Variance ratio test – Applications of F-test – Analysis of Variance(ANOVA) – Assumptions in ANOVA – Technique of ANOVA – ANOVA in Two – way classification model

Unit II: (Chapter 7)

Statistical Quality Control: Control charts - $\bar{X}$ chart – R chart – Control chart for C – Control chart for P – Advantages and limitations of Statistical quality control – Total quality management – Acceptance sampling

Unit III: (Chapter 16)

Vital Statistics: Introduction – Uses – Methods – Measurement of Fertility – Reproduction rates – Measurement of Mortality – Life tables

Unit IV: (Chapter 5 – 5.2, 5.3, 5.4, 5.5, 5.6)

Time Series Analysis: Time Series analysis – Secular Trend – Measurement of Seasonal variations – Cyclical variations – irregular variations

Unit V: (Chapter 5 – 5.7, 5.8, 5.9, 5.10)

Index Numbers: Characteristics – Uses – Methods of Constructing index numbers – Tests of consistency and adequacy – Cost of living index

Text book:

1. Dr. S.P. Gupta, Statistical methods, Sultan Chand & Sons, 46th Edition, 2021 (Unit I, II, III)
2. K. Subramani & A. Santha, Statistics for Management, Second Edition 2011. (Unit IV, V)

Reference Books:

1. S.C. Gupta & V.K. Kapoor , Fundamentals of Mathematical Statistics- Sultan Chand and Sons,11th Edition ,2014

2. R.S.N.Pillai & V. Bagavathi, Statistics –S.Chand & company LTD, Reprint 2014

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

Objectives:

1. To introduce the field of operations research which has many applications in management techniques.
2. To help students to find optimum solution in business and management problems.

Unit I:

Operations Research –An overview: Introduction – Origin and development of O.R. – Nature and features of O.R. – Applications of Operations Research - Linear programming problem: Mathematical formulation - production allocation problem, product mix problem, product allocation problem only- Graphical solution method - General LPP - Canonical and Standard forms only.

Unit II:

Linear programming problem- Simplex Method : Introduction – The computational procedure –The Simplex Algorithm – Use of Artificial variables -Two Phase method – Big- M method.

Unit III:

Transportation problem: Definition- Formulation and solution of transportation problem - Initial Basic Feasible solution - Test for optimality - degeneracy in transportation problem - Modi method.

Unit IV:

Assignment problem: Introduction - Mathematical formulation of the problem – solution methods of Assignment problems - Special cases in Assignment problems: Maximization case only.

Unit V:

Network Scheduling by PERT/ CPM:- Introduction - Network and basic components - logical sequences - Rules of Network constructions - Concurrent Activities - Critical path Analysis.

Text Book: "Operations Research" by Kanti Swarup, P.K.Gupta and Man Mohan, Sultan Chand & Sons Educational Publishers, New Delhi, 16th Edition 2014.

Reference Book: 1. Hamdy A., Taha, Operations Research, Pearson publisher, 9 th Edition,2012

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

Objectives: 1. To introduce the various techniques of Operations Research. 2. To make students solve real time problems in Business and management.

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.

UNIT – II :

Games and Strategies : Two person zero sum games - Some basic terms - the maximin - minimax principle - Games without saddle points - Mixed strategies - graphic solution of 2 x n and m x 2 games – Dominance property .

UNIT- III :

Replacement Problems : Introduction – Replacement policy when value of money does not change with time – Replacement policy when value of money changes with time – Replacement of equipment that fails suddenly - Group replacement policy .

UNIT IV :

Inventory Control : Costs associated with inventories – Factors affecting inventory control - An inventory control problem – The concept of EOQ – Deterministic inventory with no shortages – Deterministic inventory problem with shortages – problems of EOQ with price breaks.

UNIT V :

Queueing Theory – Elements of a queueing system – Classification of queueing models – Definition of transient and steady states – Poisson Queueing Systems – Model I { (M/M/1):(∞/FIFO)} – Model III {(M/M/1) : (N/FIFO)} – Model V {(M/M/C):(∞/$FIFO$)}.

Text Books: 1. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, 16th edition, Sultan Chand and Sons, Reprint 2014.

Unit I : Chapter 12- sec 12.1 to 12.5 pp.327 – 338
Unit II : Chapter 17- sec 17.1 to 17.7 pp.443 – 464
Unit III : Chapter 18 – sec 18:1, 18:2.1,18:2.2,18:3 pp.478 – 492
Unit IV : Chapter 19 – sec 19.6 to 19.12 pp. 510 – 538
Unit V : Chapter 21 – sec 21:3, 21:7, 21:8, 21:9, pp.589,590,596 to 604, 608 to 610, 613to 618

Reference Books

1. Resource Management Techniques(Operations Research) by V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan – A. R. Publications
2. Operations Research: An Introduction, 9th edition, Hamdy A.Taha, Pearson, 2010

MINOR STREAM II

MINOR -1: MATHEMATICS OF FINANCE – 4 CREDITS (60 HOURS)

UNIT I :

Ratio, Proportion and Percentage: Ratio: Definition – Continued Ratio – inverse Ratio. Proportion – Continued Proportion – Direct Proportion – Inverse Proportion – Variation – Inverse Variation – Joint Variation – Percentage: Meaning and computation of percentage. Interest: Simple interest – compound interest (reducing balance and flat interest rate) – equated monthly installments (EMI) – Problems.

UNIT II :

Matrices and Determinates (up-to order 3 only): Multivariable data - Definition of a Matrix; Types of matrices; Algebra of matrices; Determinates – Ad-joint of a matrix – Inverse of a matrix via ad-joint matrix – homogeneous system – Solution of non- homogeneous system of linear equations (not more than three variables) – Conditions for existence and uniqueness of solution – Solution using inverse of the coefficient matrix – Problems.

UNIT III :

Functions: (To identify and define the relationships that exist among the business variables) Definition of function, constants, variables, continuous real variable, domain or interval – Types of functions – one valued function – Explicit function – Algebraic functions – Polynomial functions – Absolute value function – Inverse function – Rational and irrational function – Monotone function – Even and odd function – Supply/demand function – Cost function – Total revenue function – Profit function – Production function – Utility function – Consumption function.

(Problems: 80%, Theory: 20%)

Text Books

1. **Kappor, V.K., Business Mathematics, Sultan Chand & Sons, New Delhi**

Books for References:

1. Agarwal, B.M., Basic Mathematics & Statistics, Sultan Chand & Sons, New Delhi
2. Rajagopalan, S. & Sattanathan., R., Business mathematics, McGraw-Hill, New Delhi
3. Bari, Business Mathematics, New Literature Publishing Company, Mumbai.
4. Bhardwaj, R. S. (2019). Business Mathematics and Statistics. New Delhi: Scholar Tech Press.
5. Richard, I. L., Masood, H. S., David, S. R., & Rastogi, S. (2017). Statistics for Management. New Jersey: Pearson Education.
6. Thukral, J. K. (2017). Business Mathematics and Statistics. New Delhi: Maximax Publications.
7. Vohra, N. D. (2014). Business Mathematics and Statistics. New Delhi: Tata McGraw Hill Education India.

MINOR – 2 : BUSINESS STATISTICS– 4 CREDITS (60 HOURS)

UNIT I:

Statistics-Definition-Functions, Scope and Limitations of statistics - Statistical Enquiry Stages in conducting a statistical survey-Primary data Vs secondary data-Sources of secondary data - Classification, Tabulation and Presentation of data- Diagrams.

UNIT II: Univariate Analysis

(a) Measures of Central Tendency – Average – Meaning - Characteristics of a typical average - Computation of Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted Arithmetic Mean- Merits and Limitations of each.

(b) Measures of Dispersion: Dispersion - Meaning - Properties of a good measure of dispersion - Absolute versus relative measure of dispersion - Computation of Range, Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Variation- Merits and Limitations of each.

(c) Skewness – Meaning - Variation versus Skewness - Measures of Skewness- Karl and Co-efficient of Skewness.

UNIT III: Bi-variate Analysis

(a) Simple and Liner Correlation Analysis: Meaning – Definition - Types of Correlation Methods of Studying Correlation - Correlation) and Properties.

(b) Simple and Liner Regression Analysis: Definition - CorrelationVs Regression Regression lines and Regression Equations Regression co-efficient- Computation of correlation co-efficient from regression co- efficient.

UNIT IV:

Index Numbers: Definition - Characteristics of Index numbers – Uses - Types of index numbers - Construction of Price Index numbers - Unweighted Index numbers -Weighted Index numbers - Tests of adequacy of Index number - formulae. Chain - basis index number base shifting, splicing, and deflating problems in constructing indexnumbers; Consumer price index.

UNIT V:

Analysis of Time Series: Introduction Uses - Components of time series - Measurement of trend-graphical method, semi-average method, moving average and method of least square (including linear, second degree, Parabolic and exponential trend) - Computational of seasonal, indices by simple average, Ratio - trend, ratio - to - moving average and link relative methods.

Text Books

1. J. K. Sharma, Business Statistics, Vikas Publishing House (P), Ltd., New Delhi.

2. R.S.N. Pillai and Bagavathi, Business Statistics, S. Chand & Co., New Delhi.

Books for References

1. S.P. Gupta & M.P Gupta, Statistical Methods, Sultan Chand & Co, New Delhi
2. K. Alagar, Business Statistics, Tata McGraw Hill Publications, New Delhi
3. Arora & Arora., Statistics for Management, S.Chand & Co, New Delhi

MINOR -3 : NUMERICAL ANALYSIS – 4 CREDITS (60 HOURS)

UNIT I:

Numerical solution of algebraic and transcendental equations – Bolzano's bisection method - Successive approximation method – Regula falsi method – Newton-Raphson method.

UNIT II:

Numerical solution of simultaneous linear algebraic equations – Gauss elimination method - Gauss Jordan elimination method – Gauss Seidel iteration method.

UNIT III:

Finite difference operator - Interpolation – Newton-Gregory forward and backward interpolation – Newton's divided difference formula – Lagrange's interpolation formula for uneven intervals – Gauss interpolation formula – Numerical differentiation – Numerical Integration – Trapezoidal rule – Simpson's 1/3rd rule.

UNIT IV:

Numerical solutions of Ordinary differential equations of first and second order – Simultaneous equations – Taylor series method – Picard's method.

UNIT V:

Euler's method – Improved Euler's Method - Modified Euler's Method – Runge-Kutta method of second and fourth order – Milne's predictor corrector method.

Text book

Numerical Method in Science and Engineering, M.K.Venkataraman,National Publication Co, Chennai(2001)
Unit 1: Chapter 3 and 4
Unit 2: Chapter 5
Unit 3: Chapter 6 and 9
Unit 4: Chapter 11 (Relevant portions)Unit 5: Chapter11 (Relevant portions)

ReferenceBooks

Computer oriented Numerical Methods by V. Rajaram – PHI(P) Ltd.

e-LearningSource

http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org

MINOR -4: OPTIMIZATION TECHNIQUES – I – 4 CREDITS (60 HOURS)

Objectives:

1. To introduce the field of operations research which has many applications in management techniques.
2. To help students to find optimum solution in business and management problems.

Unit I:

Operations Research –An overview: Introduction – Origin and development of O.R. – Nature and features of O.R. – Applications of Operations Research - Linear programming problem: Mathematical formulation - production allocation problem, product mix problem, product allocation problem only- Graphical solution method - General LPP - Canonical and Standard forms only.

Unit II:

Linear programming problem- Simplex Method : Introduction – The computational procedure –The Simplex Algorithm – Use of Artificial variables -Two Phase method – Big- M method.

Unit III: Transportation problem: Definition- Formulation and solution of transportation problem - Initial Basic Feasible solution - Test for optimality - degeneracy in transportation problem - Modi method.

Unit IV: Assignment problem: Introduction - Mathematical formulation of the problem – solution methods of Assignment problems - Special cases in Assignment problems: Maximization case only.

Unit V:

Network Scheduling by PERT/ CPM:- Introduction - Network and basic components - logical sequences - Rules of Network constructions - Concurrent Activities - Critical path Analysis.

Text Book: "Operations Research" by Kanti Swarup, P.K.Gupta and Man Mohan, Sultan Chand & Sons Educational Publishers, New Delhi, 16th Edition 2014.

1. Unit I : Chapter 1, 2 & 3 Sections 1.1 to 1.3, 1.10, 2.1 to 2.4, 3.2 to 3.5
2. Unit II : Chapter 4 Sections 4.1, 4.3, 4.4
3. Unit III : Chapter 10 Sections 10.1, 10.2, 10.5, 10.8, 10.9, 10.10, 10.12, 10.13
4. Unit IV : Chapter 11 Sections 11.1 to 11.4
5. Unit V : Chapter 25 Sections 25.1 to 25.6

Reference Book: 1. Hamdy A., Taha, Operations Research, Pearson publisher, 9 th Edition,2012

MINOR -5 : OPTIMIZATION TECHNIQUES – II – 4 CREDITS (60 HOURS)

Objectives: 1. To introduce the various techniques of Operations Research. 2. To make students solve real time problems in Business and management.

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.

UNIT – II :

Games and Strategies : Two person zero sum games - Some basic terms - the maximin - minimax principle - Games without saddle points - Mixed strategies - graphic solution of 2 x n and m x 2 games – Dominance property .

UNIT- III :

Replacement Problems : Introduction – Replacement policy when value of money does not change with time – Replacement policy when value of money changes with time – Replacement of equipment that fails suddenly - Group replacement policy .

UNIT IV :

Inventory Control : Costs associated with inventories – Factors affecting inventory control - An inventory control problem – The concept of EOQ – Deterministic inventory with no shortages – Deterministic inventory problem with shortages – problems of EOQ with price breaks.

UNIT V :

Queueing Theory – Elements of a queueing system – Classification of queueing models – Definition of transient and steady states – Poisson Queueing Systems – Model I { (M/M/1):(∞/FIFO)} – Model III {(M/M/1) : (N/FIFO)} – Model V {(M/M/C):(∞/$FIFO$)}.

Text Books: 1. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, 16th edition, Sultan Chand and Sons, Reprint 2014.

Unit I : Chapter 12- sec 12.1 to 12.5 pp.327 – 338
Unit II : Chapter 17- sec 17.1 to 17.7 pp.443 – 464
Unit III : Chapter 18 – sec 18:1, 18:2.1,18:2.2,18:3 pp.478 – 492
Unit IV : Chapter 19 – sec 19.6 to 19.12 pp. 510 – 538
Unit V : Chapter 21 – sec 21:3, 21:7, 21:8, 21:9, pp.589,590,596 to 604, 608 to 610, 613to 618

Reference Books

1. Resource Management Techniques(Operations Research) by V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan – A. R. Publications
2. Operations Research: An Introduction, 9th edition, Hamdy A.Taha, Pearson, 2010

MINOR – 6 : APPLIED STATISTICS– 4 CREDITS (60 HOURS)

Objectives:

1. To learn the basics of statistics concepts
2. To learn solving correlation and regression problems

Outcomes:

1. Ability to understand and represent data
2. Ability to analyze and interpret data.

UNIT I:

Diagrammatic and Graphic Presentation: General Rules for Constructing Diagrams, Types of Diagrams, One Dimensional or Bar Diagrams, Types of Bar Diagrams, Two-Dimensional Diagrams, Limitations of Pie Diagrams.

UNIT II:

Measures of Central Value: Arithmetic Mean: Calculation of Simple Arithmetic Mean- Individual Observations, Calculation of Arithmetic Mean-Discrete Series, Calculation of Arithmetic Mean-Continuous Series, Merits and Limitations of Arithmetic Mean.
Median: Calculation of Median-Individual Observations, Computation of Median-Discrete Series, Calculation of Median-Continuous Series, Merits and Limitations of Median

Mode :Calculation of Mode-Individual Observations, Calculation of Mode-Discrete Series, Calculation of Mode-Continuous Series, Merits and Limitations of Mode.

UNIT III :

Measures of Dispersion: Significance of Measuring Variation, Properties of a Good Measure of Variation, The Interquartile Range or the Quartile Deviation, Merits and Limitations, The Mean Deviation, Calculation of Mean Deviation, Calculation of Mean Deviation-Continuous Series, Merits and Limitations, The Standard Deviation, Difference Between Mean Deviation and Standard Deviation, Calculation of Standard Deviation, Merits and Limitations.

UNIT IV :

Correlation Analysis: Types of Correlation, Scatter Diagram Method, Merits and Limitations of the Method, Karl Pearson's Coefficient of Correlation, Direct Method of Finding Out Correlation Coefficient, Origin is made and Problems, Rank Correlation Coefficient, Merits and Limitations of the Rank Method.

UNIT V :

Regression Analysis: Uses of Regression Analysis, Difference Between Correlation and Regression Analysis, Regression Lines, Regression Equations, Regression Equation of Yon X, Regression Equation of X on Y and Problems

TEXT BOOK

S.P.GUPTA, "Statistical Methods", Sultan Chand & Sons, Educational Publishers, New Delhi, 2016

REFERENCE BOOK:

P.R.Vittal, "Mathematical Statistics", Margham Publications, 2016

MINOR STREAM – III

MINOR -1 : MATRICES AND TRIGONOMETRY – 4 CREDITS (60 HOURS)

Unit 1:

Martrices – rank of Matrices – Consistency of a system of linear non –homogeneous equations (statement only) – simple problems

Unit 2:

Characteristic roots of a square matrix – Evaluation of Eigen values and Eigen vectors of a vectors of a square matrix – Cayley Hamilton theorem (statement only) – simple problems – Orthogonal transformation of a symmetric matrix to diagonal form

Unit 3:

De Moivre's theorem and its applications – Direct and Inverse circular and hyperbolic functions.

Unit 4:

Logarithm of a complex quantity- Expansion of Trigonometrical functions

Unit 5:

Gregory's series- Summation of series.

Text book

1. ***Dr. P.R. Vittal, Allied Mathematics, Margham Publications, 2018***
2. ***Trigonometry, S. Narayanan and T.K. Manicavachagom Pillai, S. Viswanathan (Printers & Publishers) Pvt. Ltd, (1997)***

MINOR -2 : CALCULUS – 4 CREDITS (60 HOURS)

UNIT I :
nth derivative – Standard results – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula

UNIT II :
Total differential coefficients – Euler's theorem – Partial derivatives of a function of two functions - 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 – 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)

Textbook
Calculus Volume — I, T. K. Manickavachagom Pillai, Printers and Publishers (May1992 Edition)
Unit 1: Chapter 3 – 1.1, 1.2, 1.3, 1.4,1.5, 1.6, 2.1,
Unit 2: Chapter 8-1.3, 1.4, 1.5, 1.6, 1.7, 4, 4.1, 5,
Unit 3: Chapter 10 – 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5

Calculus Volume II , S.Narayanan and T.K. Manickavasagam Pillai (2008)
Unit 4 : Chapter 1 : 7.3, 7.4, 7.5, 8, 11
Unit 5 : Chapter 1: 12,13,14, 15.1, and Chapter 5: 2, 4,

Reference books
1. Integral Calculus, N. P. Bali, Laxmi Publications, Delhi, (1991)
2. 2. Calculus(2nd Edition), Lipman Bers and Frank Karal, Holt McDougal, 1976.
3. Thomas' Calculus 12th Edition, George B.Thomas, Maurice D.Weir and Joel Hass, Pearson Education, 2015.

MINOR -3 : VECTOR CALCULUS – 4 CREDITS (60 HOURS)

Objective: To attain the basic knowledge on vector calculus.

UNIT I :

Vector differentiation – Differentiation of vectors – Meaning of the derivative of position vector - Physical applications -– Vector differential operator - Gradient - Direction and magnitude of gradient – Simple problems.

UNIT II :

Divergence and curl - Formula involving operator, operators involving twice – Simple problems.

UNIT III:

Vector integration - Line integral – Surface integral – Volume integral – Simple problems.

UNIT IV :

Gauss divergence theorem – Green's theorem (in space) (Statement only) – Simple problems using theorems.

UNIT V :

Stoke's theorem - Green's theorem (in plane) (Statement only) – Simple problems using theorems. #

Text Book: S. Narayanan and T.K. Manicavachagom Pillai, Vector Algebra and Analysis, S.Viswanathan Pvt. Ltd. (1995).

UNIT I Chapter 4 Sections 1 - 8

UNIT II Chapter 4 Sections 9 - 12

UNIT III Chapter 6 Sections 1 - 5

UNIT IV Chapter 6 Sections 6 - 8

UNIT V Chapter 6 Sections 9, 10

Books for Reference:

1. M.L. Khanna, Vector Calculus, Jai Prakash Nath and Co., Eighth Edition (1986).

2. P.R. Vittal, Vector analysis, Analytical Geometry & sequences and series, Margham Publications, Chennai (2004).

MINOR -4 : INTRODUCTION TO DIFFERENTIAL EQUATIONS – 4 CREDITS
(60 HOURS)

Ordinary differential equations

Unit 1:

Ordinary differential equations – linear equations and equations reducible to the linear form - Exact differential equations – Equations of the First, but of higher degree – Equations solvable for dy/dx, solvable for y, solvable for x, Clairaut's form and singular solutions – geometrical meaning of a differential equations – orthogonal trajectories.

Unit 2:

Linear Differential equations with constant coefficients – Homogenous linear ordinary differential equation – linear differential simultaneous differential equations.

Partial differential equations

Unit 3:

Formation of Partial differential equations – by elimination of arbitrary constants – by elimination of arbitrary functions – Defines of general, particular and complete solutions - Singular integral – Lagranges method of solving the linear equation Pp+Qq=R

Unit 4 :

Charpits method - Linear Partial Differential equation of second and higher order with constant coefficients.

Unit 5 :

Boundary value problems method of separation of variable transverse vibrations of string – the one dimensional heat flow equations a Cartesian form.

Text books

1. **T.K. Manicavachagom Pillay , Calculus , Volume – I, S. Viswanathan (Printers and Publishers) Pvt Ltd. (2004)**
2. **Dr. M.B.K. Moorthy & K. Senthilvadivu, Transforms and partial differential equations VRB Publishers, (2009).**
3. **Transforms and Partial differential equations by Dr. A. Singaravelu**

Reference Books

1. Introductory course in Differential equations , D.A.Murray, Orient Longman (1967)
2. Engineering Mathematics , M.K.Venkataraman, National Publications , Chennai (2009)

e-Learning Source

http://ndl.iitkgp.ac.in/
http://ocw.mit.edu/
http://mathforum.org/

MINOR -5 : FOURIER SERIES AND LAPLACE TRANSFORMS – 4 CREDITS (60 HOURS)

UNIT 1:

Dirichlet's condition general Fourier series Odd and Even Functions half range Sine series and Half range cosine series.

UNIT 2:

Complex form of Fourier series Parseval's Identity.

UNIT 3:

Transform of the equation by changing the dependent variables / the independent variables – Method of variations of parameters – ordinary simultaneous differential equations.

UNIT 4:

Definition transform of 1 – transform of the function $e^{-at}, \cos at, \sin bt, t^n$, where n is a positive integer, $\sinh at, \cosh at$ - first shifting theorem – if the Laplace transform of a function f(t) is $\emptyset(s)$, then the Laplace transform of $e^{-at}f(t)$ is $\emptyset(s+a)$ - Laplace transform of $e^{-at}\cos bt, e^{-at}\sin bt, e^{-at}\ t^n$ - Second shifting theorem – Transform of $f'(t)$ and $f''(t)$ – inverse transform relating to the above standard forms.

UNIT 5:

Application to solution of ordinary differential equation with constant coefficients – involving the above transforms.

Text books

1. **Dr. M.B.K. Moorthy & K. Senthilvadivu, Transforms and partial differential equations VRB Publishers, (2009).**
2. **T.K. Manicavachagom Pillay , Calculus , Volume – I, S. Viswanathan (Printers and Publishers) Pvt Ltd. (2004)**

Reference Books

1. Introductory course in Differential equations , D.A.Murray, Orient Longman (1967)
2. Engineering Mathematics , M.K.Venkataraman, National Publications , Chennai (2009)

MINOR -6 : NUMERICAL ANALYSIS – 4 CREDITS (60 HOURS)

UNIT I:

Numerical solution of algebraic and transcendental equations – Bolzano's bisection method - Successive approximation method – Regula falsi method – Newton-Raphson method.

UNIT II:

Numerical solution of simultaneous linear algebraic equations – Gauss elimination method - Gauss Jordan elimination method – Gauss Seidel iteration method.

UNIT III:

Finite difference operator - Interpolation – Newton-Gregory forward and backward interpolation – Newton's divided difference formula – Lagrange's interpolation formula for uneven intervals – Gauss interpolation formula – Numerical differentiation – Numerical Integration – Trapezoidal rule – Simpson's 1/3rd rule.

UNIT IV:

Numerical solutions of Ordinary differential equations of first and second order – Simultaneous equations – Taylor series method – Picard's method.

UNIT V:

Euler's method – Improved Euler's Method - Modified Euler's Method – Runge-Kutta method of second and fourth order – Milne's predictor corrector method.

Text book

Numerical Method in Science and Engineering, M.K.Venkataraman,National Publication Co, Chennai(2001)
Unit 1: Chapter 3 and 4
Unit 2: Chapter 5
Unit 3: Chapter 6 and 9
Unit 4: Chapter 11 (Relevant portions)Unit 5: Chapter11 (Relevant portions)

ReferenceBooks

Computer oriented Numerical Methods by V. Rajaram – PHI(P) Ltd.

e-LearningSource

http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org

SKILL ENHANCEMENT COURSES

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

Unit 1: Fundamentals of Arithmetic

This unit focuses on the foundational principles of arithmetic, covering the Number System, including various types of numbers, their properties, and operations. It also explores the computation of the Highest Common Factor (H.C.F.) and the Least Common Multiple (L.C.M.) of numbers, along with Decimal Fractions.

Unit 2: Basic Mathematical Operations

Unit 2 is dedicated to essential mathematical operations, including Simplification techniques, efficient methods for calculating Square Roots and Cube Roots, and a comprehensive understanding of Averages.

Unit 3: Problem Solving

Unit 3 enhances problem-solving skills by addressing a wide range of numerical problems, including Problems on Numbers, Problems on Ages, and Surds and Indices.

Unit 4: Advanced Arithmetic

Unit 4 introduces more advanced arithmetic concepts, such as Logarithms, Percentage calculations, and the principles of Profit and Loss.

Unit 5: Review and Application

The final unit, Unit 5, provides an opportunity to review and apply the knowledge gained in previous units. It covers Ratio and Proportion, Partnership, and the Chain Rule for interconnected problem-solving.

Textbook References:

1. Quantitative Aptitude by R.S. Agarwal
2. Quantitative Aptitude by Abhijit Guha

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

Course Description: Logical Reasoning-I is designed to develop students' logical thinking and problem-solving abilities through various topics. This course focuses on enhancing critical thinking and decision-making skills.

Unit 1: Series Completion

This unit covers Number Series, Alphabet Series, and Alpha-Numeric Series. Students will learn to identify and complete various series patterns.

Unit 2: Analogy

Unit 2 explores Completing the Analogous Pair, Simple Analogy, Choosing the Analogous pair, Double Analogy, Word Analogy, and Number Analogy.

Unit 3: Classification / Odd One Out

This unit involves Word Classification, Number Classification, and Letter Classification, helping students identify patterns and outliers.

Unit 4: Coding – Decoding

Unit 4 introduces Letter Coding, Number Coding, Matrix Coding, Substitution, Deciphering Message Word Codes, and Jumbled Coding, enhancing code-based problem-solving skills.

Unit 5: Blood Relations

Unit 5 focuses on deciphering Jumbled up Descriptions and solving Relation Puzzles, including Direction Sense Tests.

Unit 6: Number, Ranking & Time Sequence Test

Unit 6 covers Number, Ranking & Time Sequence Tests, Arithmetical Reasoning, and Mathematical Operations.

Course Outcomes: By the end of this course, students will be able to:

1. Analyze and complete various series patterns.
2. Apply analogical reasoning to identify and complete analogous pairs.
3. Classify objects and identify odd ones out based on given criteria.
4. Decode and encode messages using various coding techniques.
5. Solve puzzles and problems related to blood relations and directional sense.
6. Apply principles of number, ranking, and time sequence tests, along with arithmetical reasoning and mathematical operations.

Textbook Reference: "Verbal and Non-Verbal Reasoning" by R.S. Agarwal

SEC 3: LATEX - 3 CREDITS (48 HOURS)

Course Outcomes: By the end of this course, students will:

1. Create basic LaTeX documents with appropriate formatting and structure as demonstrated in "Learning LaTeX."
2. Proficiently typeset mathematical equations and expressions using LaTeX, following the examples and techniques presented in the book.
3. Format and style LaTeX documents according to academic standards, drawing from the knowledge provided in "Learning LaTeX."
4. Apply advanced LaTeX features, as covered in the book, to create complex mathematical documents and presentations.
5. Use LaTeX for research, publications, and collaborative projects in mathematics, applying the principles and practices outlined in the book.

Unit 1: Introduction to LaTeX (Based on Preface and Chapter 1)

Should You Be Reading This Book?, Motivation for Learning LaTeX, Running LaTeX, Resources for LaTeX

Unit 2: Basic LaTeX (Based on Chapter 2)

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

Unit 3: Typesetting Mathematics (Based on Chapter 3)

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 (Based on Chapter 4)

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 (Based on Chapter 5)

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.

Reference Book: "Learning LaTeX" by David F. Griffiths and Desmond J. Higham

MULTI-DISCIPLINARY COURSE:

MLDC-I BASIC MATHEMATICS- 3 CREDITS (48 HOURS)

*Offered to those who had not studied Mathematics or Business mathematics in their secondary level of Education.

Unit 1 : Matrices Matrices-Elementary Concepts- Evaluation of Determinant of a square matrix - Types of Matrices-Sum and product of Matrices-Inverse of a square matrix of order 2 and order 3 – Rank of Matrix.

Unit 2 : Theory of Equations Relation between roots and coefficients - solution of equations under simple given conditions - Formation and solution of equations with imaginary and surd roots.

Unit 3 : Application of Matrices Consistency of a system of linear non-homogeneous equations (statement only)- simple problems characteristic equation of a square matrix - evaluation of eigen values – Cayley Hamilton Theorem (statement only) – verification and computing inverse using Cayley Hamilton Theorem

Unit 4 : Differential Calculus Differential coefficient of f(x) with respect to x - rules for differentiation - Differential coefficient of standard functions – Trigonometric and Inverse trigonometric functions.

Unit 5 : Differential Calculus (continued) Logarithmic differentiation - Differentiation of one function with respect to another. Integral Calculus Integration as the inverse process of differentiation - integration of standard functions.

BOOKS FOR STUDY

Manicavachgam Pillay, T.K., T. Natarajan, and K.S. Ganapathy. Algebra Vol. II. Chennai :

S. Vishwanthan printers and publishers Pvt. Ltd., 2006. Chapter 2 Sections: 1-5, 7, 8, 11, 16.

Manicavachgam Pillay, T.K., T. Natarajan, and K.S. Ganapathy. Algebra Vol. I. Chennai :

S. Vishwanthan printers and publishers Pvt. Ltd., 2006. Chapter 6 Sections: 1, 9, 10, and 11

Narayanan S., and T.K. Manicavachgam Pillay. Calculus Vol. I. Chennai : S. Vishwanthan printers and publishers Pvt. Ltd., 2004. Chapter 7 Sections: 1- 3.10, 4.1, 4.2, and 7

Narayanan S., and T.K. Manicavachgam Pillay, Ancillary Mathematics: Book II. Chennai : S. Vishwanthan printers and publishers Pvt. Ltd., 2004 . Chapter 1 Sections: 1.1- 6.1

BOOKS FOR REFERENCE

Vittal, P.R. Allied Mathematics. Chennai :Margham Publications, 2002.

Narayanan S., R. HanumanthaRao,T.K. Manicavachgam Pillay, and P. Kandaswamy. Ancillary Mathematics Vol. I. Chennai :

S.Vishwanthan printers and publishers Pvt. Ltd., 2007. Vittal, P.R., Business Mathematics. Chennai :Margham Publications, 1999