M.Sc. MATHEMATICS

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus
Regular (2022-2023)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

DEPARTMENT OF MATHEMATICS

FACULTY OF ARTS, SCIENCE ,COMMERCE AND MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established under section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the Second Cycle)
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KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established under Section 3 of UGC Act, 1956)
Coimbatore - 641 021, INDIA

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
POST-GRADUATE PROGRAMMES
(M.Sc., M.Com.)

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS - 2022

The following Regulations are effective from the academic year 2022-2023 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, Commerce and Management, Karpagam Academy of Higher Education (KAHE).

1 PROGRAMMES OFFERED,

MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 P.G. PROGRAMMES OFFERED

The various P.G. Programmes offered by the KAHE are listed in the table below.

S. No.	Programme Offered
1	M.Sc. Biochemistry
2	M.Sc. Microbiology
3	M.Sc. Biotechnology
4	M.Sc. Physics
5	M.Sc. Chemistry
6	M.Sc. Mathematics
7	M.Sc. Computer Science
8	M.Sc. Applied Astrology
9	M.Com.
10	MA English

1.2 MODE OF STUDY

Full-Time

All programmes are offered under Full-Time Regular mode. Candidates admitted under 'Full-Time' should be present in the KAHE during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

1.3 ADMSSION REQUIREMENTS (ELIGIBILITY)

Candidates for admission to the first semester Master's Degree Programme shall be required to have passed an appropriate Degree Examination of this Karpagam Academy of Higher Education or any other University accepted by the KAHE as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course as given in the table below.

QUALIFICATIONS FOR ADMISSION

S. No.	Name of the Programme Offered	Eligibility
1	M.Sc. Biochemistry	B.Sc. Degree with Biology / Biochemistry / Chemistry / Biotechnology / B.F.Sc. / Polymer Chemistry / Microbiology/ Zoology / Botany / Plant Science / Plant Biotechnology / Animal Science / Animal Biotechnology / B.Pharm / Industrial Chemistry / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics Technology / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / Medical Lab Technology / Nutrition & Dietetics
2	M.Sc. Microbiology	B.Sc. Microbiology / Applied Microbiology / Industrial Microbiology / Medical Microbiology / Botany / Zoology / Biology / Biotechnology / Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences

3	M.Sc. Biotechnology	B.Sc. Degree with Biology / Biochemistry / B.Sc Biology with Chemistry Ancillary / B.F.Sc. / Microbiology / Zoology / Botany / Plant Science /Plant Biotechnology / Animal Science /Animal Biotechnology / B.Pharm / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / B.Tech (Biotech)
4	M.Sc. Physics	B.Sc. Physics, B.Sc. Physics (CA) / B.Sc. Applied science
5	M.Sc. Chemistry	B. Sc. Chemistry, Industrial Chemistry, Polymer Chemistry
6	M.Sc. Mathematics	B.Sc. Mathematics / B.Sc. Mathematics with Computer Applications
7	M.Sc. Computer Science	B.Sc. Computer Science / Computer Technology / Information Technology / Electronics / Software Systems / BCA/ B.Sc. Applied Sciences
8	M.Com	B.Com./BCom.(CA)/B.Com(PA)/B.Com(Finance&Insurance)/ B.Com.(e-Commerce)/ B.Com.(IT) /B.B.M. /B.B.M.(CA) /B.B.A./B.B.A (CA) / B.Com (CS), B.A. Co-Operation / Bachelor's Degree in Bank Management/ B.A. Economics / B. Com Financial Analytics/ B. Com International Accounting and Finance
9	MA English	BA (English)/Any UG degree with first class in Part II - English

2 DURATION OF THE PROGRAMMES

2.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Sc., M.Com., MA	4	8

2.2 Each semester normally consists of 90 working days or 450 Instructional hours for full-time mode of study. Examination shall be conducted at the end of every semester for the respective courses.

3. CHOICE BASED CREDIT SYSTEM

3.1 All programmes are offered under Choice Based Credit System with a total credit range from 87 to 93 for the PG programmes.

3.2 Credits

Credits means the weightage given to each course of study by the experts of the Board of Studies concerned.

4. STRUCTURE OF THE PROGRAMME

Every Programme will have a curriculum and syllabus consisting of core courses, elective courses, open elective and project work.

a. Core course

Core course consists of theory and practical and the examinations shall be conducted at the end of each semester.

b. Elective course

Elective courses are to be chosen with the approval of the Head of Department concerned from the list of elective courses mentioned in the curriculum.

c. Project Work

The candidates shall undertake the project work in the Fourth Semester either in the Department concerned or in Industries, Institute or any other Organizations and the project report has to be submitted at the end of the fourth semester.

In case the candidate undertakes the project work outside the Department, the teacher concerned within the Department shall be the Main guide and the teacher/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.

d. Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and help the students in for

getting placement. Students of all programmes are eligible to enroll for the Value Added Courses. The student shall choose one Value Added Course per semester from the list of Value Added Courses available in KAHE. The examinations shall be conducted at the end of the Value Added Course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the Value Added Course for the passed out students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

e. Internship

The student shall undergo 15 days internship in the end of II semester. Internship report will be evaluated and awarded in the III semester. Students have to earn 2 credits for the Internship.100 marks is awarded for Internship through Continuous Internal Assessment.

f. Open Elective

He / She may select one of the open elective courses from the list given below offered by the other department in the third semester. Students have to earn 2 credits for this course. (The student cannot select a course offered by the parent department).

S.No.	Name of the Department	Course Code	Name of the Course
1	M.A English	22EGPOE301	English for Competitive Examinations
2	M.Com	22CMPOE301	Personal Finance and Planning
3	MBA	22MBAPOE301	Organizational behavior
4	MCA	22CAPOE301	Robotics
5	M.Sc Computer Science	22CSPOE301	Cyber forensics
6	M.Sc Mathematics	22MMPOE301	Coding theory
7	M.Sc Physics	22PHPOE301	Non-destructive techniques – an industrial approach
8	M.Sc Chemistry	22CHPOE301	Applying Chemistry to Society
9	M.Sc Microbiology	22MBPOE301	Fermentation technology
10	M.Sc Biochemistry	22BCPOE301	Nutrition and Dietetics
11	M.Sc Biotechnology	22BTPOE301	Plant Tissue culture and its applications

Online Course

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first three semesters for which examination shall be conducted at the end of the course by the respective external agencies if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies before the end of the third semester. The credit(s) earned by the students will be considered as additional credit(s) over and above the credits minimum required to earn a particular Degree.

5. MEDIUM OF INSTRUCTION

The medium of instruction for all courses, examinations, seminar presentations and project/thesis/dissertation reports should be in English.

6. MAXIMUM MARKS

The maximum marks assigned to different courses shall be as follows:

(i) Each of the theory and practical courses shall carry maximum of 100 marks. Out of which 40 marks are for Continuous Internal Assessment (CIA) and 60 marks for End Semester Examinations (ESE).

(ii) Maximum marks for Project work

S. No	Programme	Maximum marks	CIA	ESE
1	M.Sc., M.Com., MA	200	80	120

7. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate is satisfactory during the course.

b. A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of Department concerned and Dean to condone the shortage of attendance. The Head of Department has to

verify and certify the genuineness of the case before recommending to the Dean. However, the candidate has to pay the prescribed condonation fee to the KAHE.

c. However, a candidate who has secured attendance less than 64% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any and he/she has to re do the same semester with the approval of the "Students' Affairs Committee" and Registrar.

8. a. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot a certain number of students to a faculty who will function as mentor throughout their period of study. Faculty mentors shall advise the students and monitor their behavior and academic performance. Problems if any shall be counseled by them periodically. The Faculty mentor is also responsible to inform the parents of their wards progress. Faculty mentor shall display the cumulative attendance particulars of his / her ward students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy the **clause 7** of this regulation.

b. **ONLINE COURSE COORDINATOR**

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a coordinator for the online courses. The Online course coordinator shall identify the courses which the students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

9. CLASS COMMITTEE

Every class shall have a Class Committee consisting of teachers of the class concerned, student representatives (Minimum two boys and 2 girls of various capabilities and Maximum of 6 students) and the concerned HoD / senior faculty as a Chairperson. The objective of the class committee Meeting is all about the teaching – learning process. Class Committee shall be convened at least once in a month. The functions of the Class Committee shall include

- Analyzing and Solving problems experienced by students in the class room and in the laboratories.

- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.
- The Class Committee of a particular class of any department is normally constituted by the HoD / Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the class committee shall be constituted by the respective faculty Dean.
- The Class Committee shall be constituted during the first week of each semester.
- The HoD / Chairperson of the class committee are authorized to convene the meeting of the class committee.
- The respective faculty Dean has the right to participate in any class committee meeting.
- The Chairperson is required to prepare the minutes of every meeting, and submit the same to Dean within two days after having convened the meeting. Serious issues if any shall be brought to the notice of the Registrar by the HoD / Chairperson immediately.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s).

11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

11.1 Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture / practical / project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the HoD once in a fortnight for checking the syllabus coverage and records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to Dean once in a month. After the completion of the semester the HoD should keep this record in safe custody for five years. Because records of attendance and assessment shall be submitted for Inspection as and when required by the KAHE / any other approved body.

11.2 **Continuous Internal Assessment (CIA)**: The performance of students in each course will be continuously assessed by the respective faculty as per the guidelines given below:

Theory Courses

S. No.	Category	Maximum Marks
1	Attendance	5
2	Test – I (first 2 ½ units)	10
3	Test – II (last 2 ½ units)	10
4	Journal Paper Analysis & Presentation*	15
Continuous Internal Assessment : Total		40

*****Evaluated by two faculty members of the department concerned. Distribution up of marks for one Journal paper analysis: Subject matter 5 marks, Communication/PPT Presentation 4 marks, Visual aid 2 marks and Question and Discussion 4 marks

Practical Courses

S. No.	Category	Maximum Marks
1	Attendance	5
2	Observation work	5
3	Record work	5
4	Model practical examination	15
5	*Viva – voce* [Comprehensive]*	10
Continuous Internal Assessment: Total		**40**

* *Viva - voce* conducted during model practical examination.

Every practical Exercise / Experiment shall be evaluated based on the conduct of Exercise/ Experiment and records maintained.

11.3 **Pattern of Test Question Paper**

Instruction	**Remarks**
Maximum Marks	50 marks
Duration	2 Hours
Part – A	Objective type (20x1=20)
Part - B	Short Answer Type (3 x 2 = 6)
Part - C	3 Eight marks questions 'either – or' choice (3 x 8 = 24 Marks)

11.4 Attendance

Marks Distribution for Attendance

S. No.	**Attendance (%)**	**Maximum Marks**
1	91 and above	5.0
2	81 - 90	4.0
3	76 - 80	3.0
4	Less than 75	0

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12. ESE EXAMINATIONS

12.1 End Semester Examination (ESE): ESE will be held at the end of each semester for each course. The question paper is for a maximum of 60 marks.

Pattern of ESE Question Paper

Instruction	**Remarks**
Maximum Marks	60 marks for ESE
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C)
Part – A	20 Questions of 1 mark each (20 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of six marks each (5 x 6 = 30 Marks.) Question No. 21 to 25 will be 'either-or' type, covering all five

	units of the syllabus; i.e., Question No. 21: Unit - I, either 21 (a) or 21 (b), Question No. 22: Unit - II, either 22 (a) or 22 (b), Question No. 23: Unit - III, either 23 (a) or 23 (b), Question No. 24: Unit - IV, either 24 (a) or 24 (b), Question No. 25: Unit - V, either 25 (a) or 25 (b)
Part - C	Question No.26. One Ten marks Question (1 x 10 = 10 Marks)

12.2 **Practical:** There shall be combined valuation. The pattern of distribution of marks shall be as given below.

Experiments	: 40 Marks
Record	: 10 Marks
Viva-voce	: 10 Marks
Total	**: 60 Marks**

Record Notebooks for Practical Examination

Candidate taking the Practical Examination should submit Bonafide Record Notebook prescribed for the Practical Examination, failing which the candidate will not be permitted to take the Practical Examination.

In case of failures in Practical Examination, the marks awarded for the Record at the time of first appearance of the Practical Examination shall remain the same at the subsequent appearance also by the candidate.

12.3. **Evaluation of Project Work**

12.3.1 The project shall carry a maximum marks as per clause 6 (ii). ESE will be a combined evaluation of Internal and External Examiners.

12.3.2 The project report is prepared according to the approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD.

Guidelines to prepare the project report

a. Cover page
b. Bonafide certificate
c. Declaration
d. Acknowledgement
e. Table of contents
f. Chapters
   Introduction
   Aim and Objectives
   Materials and Methods (Methodology)
   Results (Analysis of Data) and Discussion (Interpretation)
   Summary
   References

12.3.3 The evaluation of the project will be based on the project report submitted and *Viva-Voce* Examination by a team consisting of the supervisor, who will be the Internal Examiner and an External Examiner who shall be appointed by the COE. In case the supervisor is not available, the HoD shall act as an Internal Examiner.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by Examination Section, the candidate is deemed to have failed in the project work and shall re-enroll for the same in a subsequent semester.

If a candidate fails in the *viva-voce* examinations he/she has to resubmit the project report within 30 days from the date of declaration of the results. For this purpose the same Internal and External examiner shall evaluate the resubmitted report.

12.3.5 Copy of the approved project report after the successful completion of *viva voce* examinations shall be kept in the KAHE library.

13. PASSING REQUIREMENTS

13.1 Passing minimum: There is a passing minimum 20 marks out of 40 marks for CIA and the passing minimum is 30 marks out of 60 marks in ESE. The overall passing in each course is 50 out of 100 marks (Sum of the marks in CIA and ESE examination).

13.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 13.1, it is mandatory that the candidate has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till he/she secures a pass both in CIA and ESE (vide Clause 2.1).

13.3 Candidate failed in CIA will be permitted to improve CIA marks in the subsequent semesters by writing tests and by re-submitting assignments.

13.4 CIA marks (if it is pass) obtained by the candidate in the first appearance shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the candidate secures a pass in ESE.

13.5 A candidate who is absent in ESE in a Course / Practical / Project work after having enrolled for the same shall be considered to have **failed** in that examination.

14. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

Candidates desirous to improve the marks secured in a passed course in their first attempt shall reappear once (**only in ESE**) in the subsequent semester. **The improved marks shall be considered for classification but not for ranking.** If there is no improvement there shall be no change in the marks awarded earlier.

15. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71- 80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AAA	-	-	ABSENT

16. GRADE SHEET

After the declaration of the results, Grade Sheets will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the corresponding grade scored.

ii. The Grade Point Average (**GPA**) for the semester and

iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA of a Semester and CGPA of a programme will be calculated as follows.

$$\textbf{GPA} \text{ of a Semester} = \frac{\text{Sum of the product of the GP by the corresponding credits of the courses offered in that Semester}}{\text{Sum of the credits of the courses of that Semester}}$$

i.e. **GPA** of a Semester = $\frac{\sum_i CiGPi}{\sum_i Ci}$

Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme

CGPA of the entire programme = ----------

Sum of the credits of the courses of the entire programme

i.e. **CGPA** of the entire programme = $\frac{\sum_n \sum_i CniGPni}{\sum_n \sum_i Cni}$

where,

Ci is the credit fixed for the course 'i' in any semester
GPi is the grade point obtained for the course 'i' in any semester
'n' refers to the Semester in which such courses are credited

Note: RA grade will be excluded for calculating **GPA** and **CGPA**.

17. REVALUATION

Candidate can apply for revaluation and retotalling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examinations will arrange for the revaluation and results will be intimated to the candidate through the HODs concerned**.** Revaluation is not permitted for supplementary theory courses.

18. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling is allowed on representation (clause 17). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wish. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), the HoD of Department concerned, the faculty of the course and

Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

A student shall be declared to be eligible for the conferment of the Degree if he / she has

- Successfully completed all the components in clause 3 and gained the required number of total credits as specified in the curriculum corresponding to his / her Programme within the stipulated period.
- Not any disciplinary action pending against him / her.
- The award of the degree must be approved by the Board of Management.

20. CLASSIFICATION OF THE DEGREE AWARDED

20.1 Candidate who qualifies for the award of the Degree (vide clause 13) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8.0** shall be declared to have passed the examination in **First Class with Distinction.**

20.2 Candidate who qualifies for the award of the Degree (vide clause 13) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in **First Class**.

20.3 All other candidates (not covered in clauses 20.1 and 20.2) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in **Second Class**.

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 A candidate due to valid reason on prior application may be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

21.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

21.3 Withdrawal of application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the HoD / Dean concerned and approved by the Registrar.

21.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

21.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

21.5 Withdrawal from the End semester examination is **NOT** applicable to arrears courses of previous semesters.

21.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

22. PROVISION FOR AUTHORISED BREAK OF STUDY

22.1 **Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme.** However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Registrar, but not later than the last date for registering for the end semester examination of the semester in question, through the HoD stating the reasons therefore and the probable date of rejoining the programme.

22.2 The candidate thus permitted to rejoin the Programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the Regulations in force at that period of time.

22.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (Vide Clause 20). However, additional break of study granted will be counted for the purpose of classification.

22.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.3) in order that he/she may be eligible for the award of the degree.

22.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered

as permitted 'Break of Study' or 'Withdrawal' (Clause 21 and 22) is not applicable for this case.

23. RANKING

A candidate who qualifies for the PG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme of study from Semester I through Semester IV to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of Study subject to a maximum of 10 ranks.

The improved marks will not be taken into consideration for ranking.

24. SUPPLEMENTARY EXAMINATION

Supplementary Examination will be conducted only for the final semester students within ten days from the date of publication of results for students who have failed in one theory course only. Such students shall apply with prescribed fee to the Controller of Examinations within the stipulated time.

25. DISCIPLINE

25.1. If a student indulges in malpractice in any of the Internal / External Examinations he / she shall be liable for punitive action as prescribed by the KAHE from time to time.

25.2. Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the KAHE. The erring students will be referred to the disciplinary committee constituted by the KAHE, to enquire into acts of indiscipline and recommend the disciplinary action to be taken.

26. REVISION OF REGULATION AND CURRICULUM

Karpagam Academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary.

DEPARTMENT OF MATHEMATICS
FACULTY OF ARTS, SCIENCE AND HUMANITIES
PG PROGRAM (CBCS) – M.Sc. Mathematics
(2022–2023 Batch and onwards)

Course code	Name of the course	Objectives and Out Comes		Instruction Hours / Week			Credit(s)	Maximum Marks			P. No.
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
SEMESTER – I											
22MMP101	Advanced Algebra	III	a, c, e	5	0	0	4	40	60	100	6
22MMP102	Advanced Real Analysis	I	a, g, e	5	0	0	4	40	60	100	8
22MMP103	Optimization Techniques	I	b, d, g	5	0	0	4	40	60	100	10
22MMP104	Theory of Ordinary Differential Equations	II	b, d, e	5	0	0	4	40	60	100	12
22MMP105A	Classical Mechanics	I	a, g	4	0	0	4	40	60	100	14
22MMP105B	Number Theory	I	a								16
22MMP105C	Finite Element Methods	II	c, e								18
22MMP111	Optimization Techniques-Practical	I	a	0	0	4	2	40	60	100	20
Journal Paper Analysis & Presentation				2	-	-	-	-	-	-	
Semester Total				**26**	**0**	**4**	**22**	**240**	**360**	**600**	
SEMESTER II											
22MMP201	Linear Algebra	III	c, e	5	0	0	4	40	60	100	22
22MMP202	Measure Theory	I	a, c	5	0	0	4	40	60	100	24
22MMP203	Mathematical Statistics	III	f	5	0	0	4	40	60	100	26
22MMP204	Theory of Partial Differential Equations	II	d, e	5	0	0	4	40	60	100	28
22MMP205A	Advanced Graph Theory	I	a	4	0	0	4	40	60	100	30
22MMP205B	Module Theory	II	c, e								32
22MMP205C	Fundamentals of Actuarial Mathematics	III	b, g								34
22MMP211	Mathematical Statistics - Practical	II	g	0	0	4	2	40	60	100	36
Journal Paper Analysis & Presentation				2	-	-	-	-	-	-	
Semester Total				**26**	**0**	**4**	**22**	**240**	**360**	**600**	
SEMESTER III											
22MMP301	Topology	III	c, e	5	0	0	5	40	60	100	38
22MMP302	Complex Analysis	I	a, g	5	0	0	5	40	60	100	40

22MMP303	Functional Analysis	III	f, g	5	0	0	5	40	60	100	42
22MMP304	Fluid Dynamics	I	i, j	5	0	0	5	40	60	100	44
22MMP305A	Fuzzy Sets and Fuzzy Logic	I	e, i	5	0	0	5	40	60	100	46
22MMP305B	Control Theory	II	d								48
22MMP305C	Neural Networks	III	b, e								50
22MMPOE301	Coding Theory	II	e	3	0	0	2	40	60	100	52
22MMP391	Internship	III	e, h	0	0	0	2	100	-	100	54
Journal Paper Analysis & Presentation				2	-	-	-	-	-	-	
Semester Total				**30**	**0**	**0**	**29**	**340**	**360**	**700**	
SEMESTER IV											
22MMP401	Operator Theory	III	c, e	5	0	0	4	40	60	100	55
22MMP402	Mathematical Methods	I	g, e, j	5	0	0	4	40	60	100	57
22MMP403	Stochastic Processes	II	j, g	5	0	0	4	40	60	100	59
22MMP491	Project	III	e	-		-	8	80	120	200	61
Semester Total				**15**	**0**	**0**	**20**	**200**	**300**	**500**	
Grand Total				**97**	**0**	**8**	**93**	**1020**	**1380**	**2400**	

Elective Courses

Elective I		**Elective II**		**Elective III**	
Course code	**Name of the course**	**Course code**	**Name of the course**	**Course code**	**Name of the course**
22MMP105A	Classical Mechanics	**22MMP205A**	Advanced Graph Theory	**22MMP305A**	Fuzzy Sets and Fuzzy Logic
22MMP105B	Number Theory	**22MMP205B**	Module Theory	**22MMP305B**	Control Theory
22MMP105C	Finite Element Methods	**22MMP205C**	Fundamentals of Actuarial Mathematics	**22MMP305C**	Neural Networks

Open Elective	
Course code	**Name of the course**
22MMPOE301	Coding Theory

DEPARTMENT OF MATHEMATICS
FACULTY OF ARTS, SCIENCE AND HUMANITIES
PG PROGRAM (CBCS) – M.Sc. Mathematics
(2022–2023 Batch and onwards)

PROGRAMME OUTCOMES (POs)

a. Solve intricate mathematical problems using the knowledge of pure and applied Mathematics.
b. Explain the knowledge of modern issues in the field of mathematics.
c. Proficiency in all lectureship exams approved by UGC.
d. Solve differential equations governing real life issues.
e. Pursue further studies and conduct research.
f. Mathematical lifelong learning through continuous professional development.
g. Employ technology in solving and understanding mathematical problems.

PROGRAM SPECIFIC OUTCOMES (PSOs)

h. Acquire knowledge of mathematics and its applications in all the fields.
i. Acquaint with the recent advances in applied mathematical sciences such as numerical computations and mathematical modeling.
j. Capable of formulating and analyzing mathematical models of real life applications.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

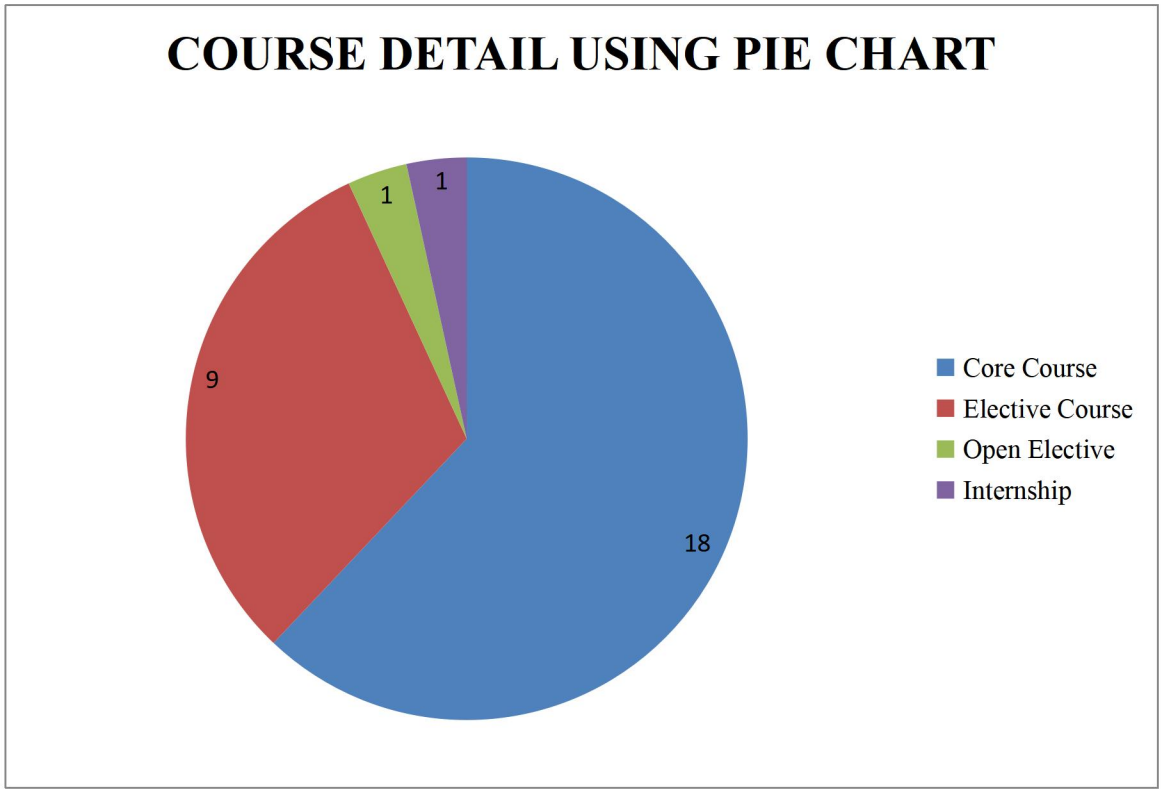
PEO I : To engender problem-solving skills and apply them to the problems of pure and applied Mathematics.

PEO II : To assimilate complicated mathematical concepts and arguments.

PEO III: To enhance your own learning and create mathematical thinking

MAPPING OF POs AND PEOs

Pos	a	b	c	d	e	f	g	h	i	j
PEO I	X		X		X			X		X
PEO II	X			X			X			X
PEO III		X				X			X	


COURSE DETAIL USING PIE CHART
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Core Course
Elective Course
Open Elective
Internship

Semester – I

22MMP101 **ADVANCED ALGEBRA** **5H –4C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**
End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Sylow's theorems, Cauchy's theorem and Index theorem.
- The concepts of direct products.
- The basic central ideas of polynomial rings.
- To test if a polynomial is irreducible finite field (Galois Fields).
- The concepts of finite field and Wedderburn's theorem.
- The fundamental concepts of algebraic ring theory and fields.

Course Outcomes (COs)

On successful completion of this course the students will be able to

1. Define conjugate and conjugate classes.
2. Recognize some advances of the theory of groups.
3. Formulate some special types of rings and their properties.
4. Understand the fundamental theorem of Galois theory.
5. Know about the concept of finite field.
6. Understand the concepts of solvable group–the commutator subgroup.

UNIT I

SYLOW'S THEOREMS

Conjugate – Normalizer – Conjugate classes–application–Cauchy's theorem – Sylow's theorems – p-Sylow's subgroup –second and third proof of Sylow's theorem.

UNIT II

FINITE ABELIAN GROUP

Double co-set–Sylow's in doubt co-set. Internal and external direct product–isomorphism–Finite abelian groups–invariant.

UNIT III

POLYNOMIAL RINGS

Polynomial rings – Degree of polynomial – Polynomials over the rational field– Primitive – Content of the polynomial – Gauss lemma – integer monic – Eisenstein Criterion –Polynomial rings over commutative rings– unique factorization domain.

UNIT IV

GALOIS THEORY

Extension field – Root of the polynomial - More about roots – derivative –simple extension– fixed field - Normal extension - Splitting field – Galois group–fundamental theorem of Galois theory.

UNIT V

FINITE FIELD

Solvable group – the commutator subgroup – solvability by radicals – Finite fields – Wedderburn's theorem on finite division rings.

TEXT BOOK

1. Herstein I. N., (2006). Topics in Algebra, Second edition, Wiley and sons Pvt, Ltd, Singapore.

REFERENCES

1. Michiel Hazewinkel., Nadiya Gubareni., and Kirichenko V.V., (2011). Algebras, Rings and Modules, Vol.1, Springer International Edition, (Indian Print).
2. Artin M., (2015). Algebra, Pearson Prentice-Hall of India, New Delhi.
3. Fraleigh J.B., (2013). A First Course in Abstract Algebra, Seventh edition, Pearson Education Ltd, New Delhi.
4. Kenneth Hoffman., and Ray Kunze., (2015). Linear Algebra, Second edition, Prentice Hall of India Pvt Ltd, New Delhi.
5. Vashista A.R., (2014). Modern Algebra, Krishna Prakashan Media Pvt Ltd, Meerut.

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2. https://ocw.mit.edu/courses/mathematics/18-702-algebra-ii-spring-2011/index.htm
3. https://www.youtube.com/watch?v=PN-cro0J_v8&list=PLEAYkSg4uSQ1Yhxu2U-BxtRjZElrfVVcO
4. http://172.16.25.76/course/view.php?id=1646

Semester – I

22MMP102 ADVANCED REAL ANALYSIS 5H –4C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The derivative of real functions.
- The principles of Riemann – Stieltjes Integral.
- The concept of sequence and series of functions.
- Applications of mathematical concepts and principles in power series.
- The concept of inverse implicit function and relevant theorem.
- To identify sets with various properties such as finiteness, countability, and infiniteness.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Apply the concept of mean value theorem for differentiable functions.
2. Get specific skill in Riemann Stieltjes integral and Lebesgue integral.
3. Attain working knowledge in sequence and series.
4. Understand exponential and logarithmic functions.
5. Apply implicit and inverse function theorem moving towards calculus on manifolds.
6. Describe the fundamental concepts of some special functions.

UNIT I

DIFFERENTIATION

The derivative of real function – mean value theorems-The continuity of derivatives-L'Hospital rule – Derivatives of higher order – Taylor's theorem - Differentiation of vector-valued functions.

UNIT-II

THE RIEMANN STIELTJES INTEGRAL

The Riemann-Stieltjes integral: Definition and existence of the integral – Properties of the integral - Integration and differentiation - Integration of vector valued functions – Rectifiable curves.

UNIT III

SEQUENCES AND SERIES OF FUNCTIONS

Sequences and series of functions: Discussion of Main problem–Uniform Convergence-Uniform convergence and continuity - Uniform convergence and Integration - Uniform convergence and differentiation - Equicontinuous families of functions - The Stone-Weierstrass theorem.

UNIT IV

SOME SPECIAL FUNCTIONS

Some special functions: Power series - The exponential and Logarithmic functions - The trigonometric functions - The algebraic completeness of the complex field – Fourier Series - The Gamma functions.

UNIT V

IMPLICIT FUNCTIONS AND EXTREMUM PROBLEMS

Introduction–Functions with non-zero Jacobian determinant– The contraction principle - Inverse function theorem–Implicit function theorem – Extrema of real valued functions of one variable and several variables

TEXT BOOK

1. Rudin W., (2013). Principles of Mathematical Analysis, Tata McGraw Hill, New York.

REFERENCES

1. Balli N.P., (2017). Real Analysis, Laxmi Publication Pvt Ltd, New Delhi.
2. Bartle R. G., and Sherbert D. R., (2015). Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd.
3. Gupta S. L., and Gupta N. R., (2003). Principles of Real Analysis, Second edition, Pearson Education Pvt. Ltd, Singapore.
4. Royden H. L., (2002). Real Analysis, Fourth edition, Prentice Hall of India, New Delhi.
5. Sterling K., and Berberian., (2020). A First Course in Real Analysis, Springer Pvt Ltd, New Delhi.
6. Apostol M., (2002). Mathematical Analysis, Second edition, Narosa Publishing House, New Delhi.

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2. https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall 2012/index.htm
3. http://172.16.25.76/course/view.php?id=1647.

Semester – I

22MMP103 OPTIMIZATION TECHNIQUES 5H –4C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**
End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The basic concepts of integer linear programming.
- To solve quadratic programming problems, dynamic programming problems and non-linear programming problems.
- The concepts of inventory models.
- Real life applications in decision analysis.
- Different optimization techniques in NLP.
- Fundamentals of Linear Programming and Dynamic Programming problems.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Understand the concept of linear programming and integer programming.
2. Develop dynamic programming problems.
3. Familiarize with real life applications of inventory control.
4. Skill in decision analysis.
5. Mastery in Beale's method and simplex method.
6. Use classical optimization techniques and numerical methods of optimization.

UNIT I

INTEGER LINEAR PROGRAMMING

Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory's All Integer Cutting Plane Method-Gomory's mixed Integer Cutting Plane method Branch and Bound Method. Zero-One Integer Programming–Real life application in Integer Linear Programming.

UNIT II

DYNAMIC PROGRAMMING

Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming under Certainty - DP approach to solve LPP.

UNIT III

INVENTORY CONTROL

Introduction – Costs involved in Inventory – Deterministic EOQ Models – Purchasing Model without and with Shortage, Manufacturing Model without and with Shortage -Price Break. Probabilistic Inventory Model - Real life application - Continuous review models - Probabilistic Economic order quantity (EOQ) Model.

UNIT IV

DECISION ANALYSIS

Real life application - Decision making under certainty- Analytic hierarchy process. Decisions under Risk- Decision Trees-based expected value criterion, variations of the expected value criterion. Decisions under Uncertainty Real life application in Decision Analysis

UNIT V

NON-LINEAR PROGRAMMING METHODS

Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods - Beale's Method.

TEXT BOOK

1. Kantiswarup., Gupta P. K., and Manmohan., (2019). Operations Research, Twelfth edition, Sultan Chand & Sons Educational Publishers, New Delhi.

REFERENCES

1. Srinivasan.G, (2008), Operations Research Principles and Applications, PHI Learning Private Ltd, New Delhi.
2. Handy A Taha., (2017). Operations Research, Tenth edition, Prentice Hall of India Pvt Ltd, New Delhi.
3. Sharma J. K., (2019). Operations Research Theory and Practice, Fourth edition, Macmillan India Ltd.
4. Panneerselvam R., (2016). Operations Research, Second edition, Prentice Hall of India Private Ltd, New Delhi.
5. Singiresu S., and Rao., (2010). Engineering Optimization Theory and Practice, Third edition New Age International Pvt Ltd, New Delhi.
6. Sivarethina Mohan R., (2008). Operations Research, First edition, Tata McGraw Hill Publishing Company Ltd, New Delhi.

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2. http://172.16.25.76/course/view.php?id=2082

Semester –I

22MMP104 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS 5H–4C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- About the concept of differential equations with variable coefficients.
- The formulation and solutions of second order ordinary differential equations.
- The concept of the system of first order equations with solving technique.
- The existence of uniqueness and non-uniqueness of solutions in the systems.
- The concepts of elementary linear and nonlinear oscillations.
- Problem solving procedures to thoroughly investigate relevant physical models.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Understand the standard methods and method of variation of parameters.
2. Understand the existence and uniqueness of solution to differential equations.
3. Identify non homogeneous equations, linear system with constant coefficients.
4. Solve higher order and system of differential equations by Successive approximations.
5. Understand the difficulty of solving problems for elementary linear oscillations.
6. Solve physical situations whose behavior can be described by ordinary differential equations.

UNIT I

LINEAR EQUATIONS

Linear independence – Equations with Constant Coefficients- Equations with Variable Coefficients - A formula for the Wronskian – Variation of parameters- Some Standard Methods- Method of Laplace Transforms.

UNIT II

SECOND ORDER LINEAR EQUATIONS

Second order linear equations with ordinary points – Legendre equation and Legendre polynomial-Second order equations with regular singular points – Bessel equation.

UNIT III

SYSTEMS OF LNEAR DIFFERENTIAL EQUATIONS

System of first order equations – existence and uniqueness theorems – fundamental matrix. Nonhomogeneous linear system–linear systems with constant coefficient – Linear systems with periodic coefficients -Annihilator method to solve non-Homogenous equation.

UNIT IV

SUCCESSIVE APPROXIMATION AND NON-UNIQUENESS SOLUTIONS

Successive approximation – Picard's theorem – Non uniqueness of solution – Continuation and dependence on initial conditions – Existence of solution in the large existence and uniqueness of solution in the system.

UNIT V

OSCILLATION THEORY

Oscillation Theory and Boundary value problems – Qualitative Properties of Solutions – Eigenvalues, Eigenfunctions and the Vibrating String - Fundamental results – Strum's comparison theorem – Strum's Separation theorem - Elementary linear oscillations – Comparison theorem of Hille winter – Oscillations of $x'' + a(t)x = 0$ elementary nonlinear oscillations.

TEXT BOOK

1. Deo S. G., Lakshmikantham V., and Raghavendra V., (2005). Ordinary Differential Equations and Stability Theory, Second edition, Tata McGraw Hill Publishing Company limited, New Delhi.

REFERENCES

1. Earl A Coddington., (2008). An introduction to Ordinary differential Equations, Prentice Hall of India Private limited, New Delhi.
2. Rai. B., Choudhury D. P., and Freedman H. I., (2004). A course of Ordinary differential Equations, Narosa Publishing House, New Delhi.
3. George F Simmons., (2017). Differential Equations with application and historical notes, 3rd edition by Taylor & Francis Group, LLC.
4. Williams E. Boyce and Richard C. Diprima, (2012) Elementary Differential Equations and Boundary Value Problems, 10th edition, John Wiley and Sons, New York.

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2. https://www.youtube.com/watch?v=4QllSn2v7p4&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6glD&index=14
3. http://172.16.25.76/course/view.php?id=1649
4. https://nptel.ac.in/courses/111/104/111104031/#

Semester – I

22MMP105A **CLASSICAL MECHANICS** **4H –4C**

Instruction Hours/week:L:4 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Momentum applications Lagrange and D'Alembert's principle.
- Applications of differential equations in advanced mathematical problems.
- Parameters defining the motion of mechanical systems and their degrees of freedom.
- About canonical transformations.
- The principal and characteristic functions of Hamilton Jacobi equations.
- The Hamilton-Jacobi equation of the variation methods.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Understand the concept of the D'Alembert's principle.
2. Derive the Lagrange's equation for holomonic and non holomonic constraints.
3. Solve the problems of Hamilton equations of motion.
4. Study in details about the canonical transformations.
5. Know the concept of Hamilton Jacobi theory.
6. Concepts of Routh's procedure.

UNIT I

SURVEY OF ELEMENTARY PRINCIPLES

Constraints - Generalized coordinates, Holonomic and non- holonomic systems, Scleronomic and Rheonomic systems. D'Alembert's principle and Lagrange's equations – Velocity – dependent potentials and the dissipation function – some applications of the Lagrange formulation.

UNIT II

VARIATION PRINCIPLES AND LAGRANGE'S EQUATIONS

Hamilton's principle – Some techniques of calculus of variations – Derivation of Lagrange's Equations from Hamilton's principle – Extension of Hamilton's principle to non-holonomic systems – Conservation theorems and symmetry properties – energy functions and the conservation of energy

UNIT III

HAMILTON EQUATIONS OF MOTION

Legendre Transformations and the Hamilton Equations of motion-canonical equations of Hamilton – Cyclic coordinates and conservation theorems – Routh's procedure - Derivation of Hamilton's equations from a variational principle – The principle of least action.

UNIT IV

CANONICAL TRANSFORMATIONS

The equations of canonical transformation – Examples of Canonical transformations – The Symplectic approach to Canonical Transformation – Poisson Brackets and other Canonical invariants – integral invariants of Poincare, Lagrange brackets.

UNIT V

HAMILTON JACOBI THEORY

Hamilton Jacobi equations for Hamilton's principal function – Harmonic oscillator problem – Hamilton Jacobi equation for Hamilton's characteristic function – Separation of variables in the Hamilton-Jacobi equation – Ignorable coordinates and the Kepler problem.

TEXT BOOK

1. Goldstein H., (2011). Classical Mechanics Third Edition, Narosa Publishing House, New Delhi.

REFERENCES

1. Gantmacher F., (2013). Lectures in Analytic Mechanics, MIR Publishers, Moscow.
2. Gelfand I. M., and Fomin S.V., (2003). Calculus of Variations, Prentice Hall, New Delhi.
3. Loney S. L., (2015). An Elementary Treatise on Statics, Kalyani Publishers, New Delhi.

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2. https://www.youtube.com/playlist?list=PLq-Gm0yRYwTjpY9BlDxFGNXIaQJIOQRdo
3. http://172.16.25.76/course/view.php?id=16

Semester – I

22MMP105B **NUMBER THEORY** **4H –4C**

Instruction Hours/week:L:4 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Fundamentals of congruences.
- Momentous number theoretic functions.
- The challenging problems in number theory.
- Application of number theory in cryptography.
- Greatest common divisor, prime, and prime-factorization.
- The Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the concepts of divisibility and prime,
2. Know about the Fermat's Little theorem.
3. Mastery in Mobius Inversion formula.
4. Familiar with the concepts of primitive roots
5. Acquire working knowledge in cryptography.
6. Acquire knowledge in the Legendre symbol and its properties.

UNIT I

ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION

The Mobius function $\mu(n)$ – The Euler totient function $\phi(n)$ – A relation connecting μ and ϕ - A product formula for $\phi(n)$ – The Dirichlet product of arithmetical functions – Dirichlet inverses and the Mobius inversion formula – The Mangoldt function $\Lambda(n)$ – Multiplicative functions – Inverse of a completely multiplicative function.

UNIT II

AVERAGES OF ARITHMETICAL FUNCTION

The big oh notation – asymptotic equality of functions – Euler's summation formula – elementary asymptotic formulas – Average order of $d(n)$, of divisor function $\sigma_\alpha(n)$, $\phi(n)$, $\mu(n)$ and $\Lambda(n)$.

UNIT III

CONGRUENCES

Basic properties – Residue classes and complete residue systems – linear congruences – Reduced residue systems and Euler Fermat theorem – Polynomial congruences modulo p – Lagrange's theorem – Applications – Simultaneous linear congruences – The Chinese remainder theorem – Polynomial congruences with prime power moduli.

UNIT IV

QUADRATIC RESIDUES & THE QUADRATIC RECIPROCITY LAW

Quadratic Residues – Legendre's symbol and its properties – Evaluation of $\left(-\frac{1}{p}\right)$ and $\left(\frac{2}{p}\right)$ – Gauss' lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol.

UNIT V

PARTITIONS

Geometric representation of partitions – Generating functions for partitions – Euler's pentagonal- number theorem – Euler's recursion formula for $p(n)$.

TEXT BOOK

1. Tom M.Apostol, Introduction to Analytic Number Theory, Springer International Student Edition, Narosa Publishing House, New Delhi

REFERENCES

1. Ivan Niven, Herbert S.Zuckermann., (1989), An Introduction to the Theory of Numbers, Wiley Eastern University Edition, V Edition.
2. Leveque.W.J, Topics in Number Theory, Addison Wesley.
3. Bressoud, D., Wagon, S., A, (2000), Course in Computational Number Theory, Key College Publishing.

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2. http://vidyamitra.inflibnet.ac.in/index.php/content/index/5704c5378ae36c6ab9b0b9d1
3. http://172.16.25.76/course/view.php?id=1653

Semester – I

22MMP105C	**FINITE ELEMENT METHODS**	**4H –4C**

Instruction Hours/week:L:4 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The fundamental concepts of the theory of the finite element method.
- The purpose of Galerkin method, global & local finite element models in one dimension.
- Finite elements method with a focus on one- and two-dimensional problems.
- The zero order Hermitian interpolations functions and sample of planner rectangular Lagrange elements.
- The global interpolation and the solution of one-dimensional heat and wave equations.
- The design and heat transfer problems with application of finite element method.

Course Outcomes (COs)

On successful completion of this course the students will be able to

1. Develop the ability to generate the governing finite element equations for systems governed by partial differential equations.
2. Analyze the composite laminates with local effects global /local finite element methods.
3. Develop triangular and rectangular elements for the general plain elasticity problems.
4. Understand the concepts Lagrangian and Hermit elements methods in finite element method.
5. Understand the application and uses of the Finite element method for heat transfer problem.
6. Apply the computational technique to obtain the approximate solutions of boundary value problems.

UNIT I

Finite Element Method: Variation formulation–Raayleigh- ritz minimization- weighted residuals- Galerkin method applied to boundary value problems.

UNIT II

Global and local finite element models in one dimension-derivation of finite element equation.

UNIT III

Finite element interpolation-polynomial elements in one dimension, two dimensional elements-natural coordinates-triangular elements-rectangular elements.

UNIT IV

Lagrangian and Hermit elements for rectangular elements-global interpolation functions.

UNIT V

Local and global forms of finite element equations-boundary conditions-methods of solutions for a steady state problem –Newton-Raphson continuation-one dimensional heat and wave equations.

TEXT BOOK

1. Reddy J. N., (2009). An Introduction to the Finite element Method. McGraw Hill, New York.

REFERENCES

1. Chung., (2001). Finite element Analysis in Fluid Dynamics., Mc Graw Hill, Inc.
2. Singiresu S., and Rao., (2004). The Finite Element Method in Engineering, Fourth edition, ElsevierInc.
3. Chennakesava R., and Alavala., (2012). Finite Element Method, PHI, New Delhi.
4. Zienkiewicz O. C., and Talor R. L., (2010). Finite Element Method its Basis and Fundamentals, Elsevier, New Delhi.

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2. https://www.kth.se/social/upload/5261b9c6f276543474835292/main.pdf
3. https://www.youtube.com/watch?v=C6X9Ry02mPU
4. https://www.youtube.com/watch?v=hVleTL6CeKw

Semester–I

22MMP111 OPTIMIZATION TECHNIQUES–PRACTICAL 4H–2C

Instruction Hours/week: L:0 T:0 P:4 **Marks:**Internal:**40** External: **60** Total:**100**
End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- An exposure to develop well-structured optimization techniques knowledge arising process in various level of science.
- The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.
- This module aims to introduce students to use Probabilistic Model and techniques.
- The course aims at providing fundamental knowledge and exposure of the concepts, theories and practices in the field of management.
- Study the basic components of an optimization problem.
- Formulation of design problems as mathematical programming problems.

Course Outcomes

On successful completion of this course, the student will be able to

1. Use the object oriented concepts for implementation of Optimization Techniques.
2. Implement the data structure concepts for Optimization Techniques problems.
3. Acquire skills to solve various multivariable optimization problems
4. Solve of different optimization problems.
5. Identify and develop operational research models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems.
6. Use mathematical software to solve the proposed models.

List of Practical:

1. Solution for a system of equations- Simplex method.
2. EOQ for purchasing model without shortage
3. EOQ for manufacturing model without shortage
4. EOQ for manufacturing model with shortage
5. EOQ for purchasing model with shortage
6. Probabilistic Model-EOQ.

7. Decision making with minimax criterion.
8. Decision making with maximin criterion.
9. Decision making under risk.
10. Decision making with Hurwicz criterion.

REFERENCES

1. LAB Manual.
2. Kirani Singh. Y & Chaudhuri. B.B., (2008). MATLAB Programming, Prentice-Hall of India Pvt. Ltd, New Delhi.
3. Desmond. J. Higham & Nicholas J. Hiham., (2005). MATLAB Guide MATLAB Guide, MATLAB Guide, 2nd edition, SIAM.
4. Hema Ramachandran, Achuthsankar S. Nair, Computer SCILAB–A Free Software to MATLAB, First Edition, S. Chand & Company Ltd, New Delhi.

WEBSITE LINK:

1. http://spoken-tutorial.org/
2. http://wiki.scilab.org/Tutorialsarchives
3. https://www.scilab.org/tutorials

Semester – II

22MMP201 **LINEAR ALGEBRA** **5H –4C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The concepts of linear transformations.
- Momentous properties of algebra of polynomials.
- About determinants and its properties.
- Normalization of vectors.
- The concept of cyclic decomposition.
- The solution in canonical and vector forms.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Recognize some advances of vector spaces and linear transformations.
2. Understand the concept of prime factorizations of polynomials.
3. Attain mastery in determinant functions.
4. Decompose a given vector space in to certain canonical forms.
5. Know the concept of rational form.
6. Formulate several classes of linear transformations and their properties.

UNIT I

LINEAR TRANSFORMATIONS

Linear transformation–null space–rank–nullity–Algebra of linear transformation. The algebra of linear transformations-Isomorphism – Representation of transformations by matrices – Linear functional.

UNIT II

POLYNOMIALS

Linear algebras over the field – Algebra of polynomials– Lagrange Interpolation– isomorphic – Polynomial ideals– root – Taylor's Formula – ideal – greatest common divisor – relatively prime – the prime factorization of a polynomial.

UNIT III

DETERMINANTS

Commutative Ring– Determinant Functions– n-linear – Permutations– degree of permutation – Signature of permutation – the Uniqueness of Determinants– Additional Properties of Determinants.

UNIT IV

ELEMENTARY CANONICAL FORM

Introduction– Characteristic Values– Characteristic vector – Characteristic space – example – Diagonalizable – Annihilating Polynomials– Invariant Subspaces– Simultaneous Triangulation– Simultaneous Diagonalization.

UNIT V

THE RATIONAL AND JORDAN FORM

Cyclic Subspaces and Annihilators– Cyclic Decompositions theorem – generalized Cayley Hamilton theorem – The Jordon Form.

TEXT BOOK

1. Kennath M Hoffman., and Ray Kunze., (2015). Linear Algebra, 2 Edition, Pearson India Publishing, New Delhi.

REFERENCES

1. Herstein I. N., (2006). Topics in Algebra, 2nd Edition, John Wiley & Sons, Singapore.
2. Vivek Sahai., and Vikas Bist., (2013). Linear Algebra, Second edition, Narosa Publishing House.
3. Rao A. R., and Bhimashankaram P., (2000). Linear Algebra, Tata Mc Graw Hill, New Delhi.
4. Golan J. S., (2010). Foundations of linear Algebra, Kluwer Academi publisher.
5. Kumaresan S., (2006). Linear Algebra A Geometric Approach, Prentice Hall of India.

WEBSITE LINK

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25
2. http://vidyamitra.inflibnet.ac.in/index.php/content/index/5704c5378ae36c6ab9b0b0fa
3. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/
4. https://ocw.mit.edu/courses/mathematics/18-s096-topics-in-mathematics-with-applications-in-finance-fall-2013/video-lectures/lecture-2-linear-algebra/

Semester – II

22MMP202 **MEASURE THEORY** **5H –4C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The concepts of measure theory and their measure.
- The fundamental principles of measure theory and integration.
- The concept of differentiation of monotone functions.
- Properties of the basic concepts Riemann integral and Lebesgue integral.
- Momentous signed measures.
- Imperative of measure theory to deal with concept such as probability, statistics.

Course Outcomes (COs)

After successful completion of this course the students will be able to:

1. Get a clear view of the fundamentals of measure theory.
2. Acquaint with the proofs of the fundamental theorems underlying the theory of Lebesgue integration.
3. Identify the impact of measure theory in differentiation of an integral.
4. Mastery in the measure spaces and its properties.
5. Apply Lebesgue decomposition and the Radon-Nikodym theorem.
6. Apply the theorems of monotone and dominated convergence and Fatou's lemma.

UNIT I

MEASURES

Introduction – Outer measure – Measurable sets and Lebesgue Measure – A non-measurable set – Measurable functions – Littlewoods's three principles.

UNIT II

FUNCTIONS AND INTEGRALS

The Riemann integral – The Lebesgue integral of a bounded function over a set finite measure – The integral of a non-negative function–The general Lebesgue integral–Convergence in measure.

UNIT III

DIFFERENTIATION

Differentiation of monotone function– Functions of bounded variation–differentiation of an integral-Absolute continuity.

UNIT IV
MEASURESPACES
Measure spaces-Measurable functions-Integration-General convergence Theorems.

UNIT V
SIGNED MEASURES
Signed measures-The Radon-Nikodym theorem-the L^P spaces.

TEXT BOOK

1. Royden H. L., (2008). Real Analysis, Third Edition, Prentice – Hall of India Pvt. Ltd, New Delhi.

REFERENCES

1. Keshwa Prasad Gupta., (2014). Measure Theory, Krishna Prakashan Ltd, Meerut.
2. Donald L Cohn., (2013). Measure Theory, United States.
3. Paul R Halmos., (2008). Measure Theory, Princeton University Press Dover Publications, NewYork.
4. Rudin W., (2017). Real and Complex Analysis, 3rd Edition, Mcgraw–Hill Education India PvtLtd, New Delhi.
5. G de Barra., (2014), Measure Theory and Integration, Ist Edition, New Age International Publishers, India

WEBSITE LINK:

1. https://ocw.mit.edu/courses/mathematics/18-125-measure-and-integration-fall-2003/
2. https://www.youtube.com/playlist?list=PLgMDNELGJ1CYKDzKdGcM1-kuH_a1NCfQA
3. http://172.16.25.76/course/view.php?id=2069

		Semester – II
22MMP203	**MATHEMATICAL STATISTICS**	**5H –4C**

Instruction Hours/week:L:5 T:0 P:0	**Marks:**Internal:**40**	External: **60** Total:**100**
		End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- To understand the basic concepts in probability generating functions, sample moments and their functions, sampling, significance tests and statistical measures
- Probability distributions, significance of testing hypothesis and its interpretation.
- About non parametric tests.
- Estimation, ANOVA and their applications in various disciplines.
- The knowledge of fixed-sample and large-sample statistical properties of point and big data concepts.
- Understanding of how to design experiments and surveys for efficiency.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Explain the concepts of probability, including conditional probability.
2. Explain the concepts of a statistical tests.
3. Summarize the main features of a data set and test statistical hypotheses.
4. Define basic estimations and analysis of variance.
5. Explain the concepts of Artificial intelligence and Machine Learning.
6. Describe the main methods of estimation and the main properties of estimators, and apply them.

UNIT I

INTRODUCTION TO PROBABILITY AND HYPOTHESIS TESTING

Random Events – Preliminary remarks – random events and operations performed on them – the system of axioms of the theory of probability – conditional probability – Bayes theorem – Independent Events – functions of random variables –Introduction to hypothesis testing, Population and Sample - Parameter and Statistic, Sampling and its methods, type-I and type-II errors, standard error, confidence interval, confidence limits. Level of Significance and degrees of freedom.

UNIT II

PARAMETRIC TESTS

Concept of a statistical test, Small and Large sample tests - t- test, two sample t- test, Z- test - one tailed test about population mean when sigma known, two tailed test about population mean when sigma known, one tailed test about population mean when sigma unknown, two tailed test about population means.

UNIT III

NON-PARAMETRIC TESTS

Difference between Parametric and Non-parametric tests. Non-parametric tests - Chi-square test- Goodness of fit test, Independence Tests by contingency tables. Kolmogorov Theorem-Smirnov Theorem-Tests of Kolmogorov and Smirnov test for comparing two populations, The Wald- Wolfovitz and Wilcoxon-Mann-Whitney tests.

UNIT IV

ESTIMATION AND ANALYSIS OF VARIANCE (ANOVA)

Preliminary notion-Consistency Estimation - Unbiased estimates – Sufficiency – Efficiency - Asymptotically most efficient estimates -methods of finding estimates -confidence Interval. Analysis of Variance: One way classification and two-way classification.

UNIT V

STATISTICAL LEARNING AND DATA ANALYTICS

Introduction to Big data concepts, Artificial intelligence and Machine Learning, Classification of Data Analytics and Popular Software used for Data Analytics - EXCEL, SPSS, Python, R-Programming.

TEXT BOOK

1. Marek Fisz., (1980). Probability Theory and Mathematical Statistics, John Wiley and Sons, New York.

REFERENCES

1. Meyer., (2006). Introduction to Probability and Statistical applications, Oxford and IBH Publishing Co. Pvt Ltd. New Delhi.
2. Dinesh Kumar D., (2017). Business Analytics: The Science of Data - Driven Decision Making, Wiley, New Delhi.
3. Srivastava T.N., and Shailaja Rego., (2012). 2e, Statistics for Management, McGraw Hill Education, New Delhi.
4. Sheldon M Ross., (2009). Introduction to probability and statistics for engineers and scientists, Third edition, Academic press.
5. Parimal Mukhopadhyay., (2012). Theory of Probability, New central book agency, Calcutta.

WEBSITE LINK:

1. https://ocw.mit.edu/courses/mathematics/18-175-theory-of-probability-spring-2014/index.htm
2. https://www.youtube.com/playlist?list=PLRw1YtKsDxwqIE8WVFtL2Q_s8Sk7LkC
3. http://172.16.25.76/course/view.php?id=1655

Semester –II

22MMP204 THEORY OF PARTIAL DIFFERENTIAL EQUATIONS 5H –4C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Second order partial differential equations with constant coefficients.
- The behavior of elliptic partial differential equations.
- The concepts of parabolic differential equations.
- The solution of one-dimensional wave equations.
- The concepts of Laplace transform and Laplace equations.
- The solution of Partial Differential Equation of practical application like in Engineering, Physics, etc.,

Course Outcomes (COs)

On successful completion of this course the students will be able to

1. Recognize the major classification of PDEs and the qualitative difference between the classes of equations.
2. Apply elliptic differential equations in almost all areas of mathematics, from harmonic analysis to geometry to Lie theory.
3. Analyze diffusion equations in cylindrical – Spherical co-ordinates
4. Acquire the knowledge of wave equation and vibrating membranes.
5. Evaluate Laplace equation and analyze its applications.
6. Familiar with the modeling assumptions and derivations that lead to PDE's.

UNIT I

SECOND ORDER PARTIAL DIFFERENTIAL EQUATIONS:

Origin of second order partial differential equations – Linear differential equations with constant coefficients – Method of solving partial (linear) differential equation – Classification of second order partial differential equations – Canonical forms – Adjoint operators – Riemann method.

UNIT II

ELLIPTIC DIFFERENTIAL EQUATIONS:

Elliptic differential equations – Occurrence of Laplace and Poisson equations – Boundary value problems – Separation of variables method – Laplace equation in cylindrical – Spherical coordinates, Dirichlet and Neumann problems for circle – Sphere.

UNIT III

PARABOLIC DIFFERENTIAL EQUATIONS

Parabolic differential equations – Occurrence of the diffusion equation – Boundary condition – Separation of variable method – Diffusion equation in cylindrical – Spherical co-ordinates.

UNIT IV

HYPERBOLIC DIFFERENTIAL EQUATIONS:

hyperbolic differential equations – occurrence of wave equation – one dimensional wave equation – reduction to canonical form – D'Alembert solution – separation of variable method – periodic solutions – cylindrical – spherical co-ordinates – Duhamel principle for wave equations.

UNIT V

INTEGRAL TRANSFORM:

Laplace transforms – Solution of partial differential equation – Diffusion equation – Wave equation – Fourier transform – Application to partial differential equation – Diffusion equation – Wave equation – Laplace equation.

TEXT BOOK

1. Raisinghania. M. D. (2005). Ordinary and Partial Differential equations, S. Chand & Company PVT.LTD, Ramnagar, New Delhi-1110 055

REFERENCES

2. Sharma J. N., and Keharsingh., (2009). Partial Differential Equations for Engineering and Scientists, Narosa Publishing House, New Delhi.
3. Ian N Sneedon., (2006). Elementary Partial differential equations, Tata Mcgraw Hill Ltd.
4. Sankara Rao K., (2011). Introduction to Partial Differential Equations, Third edition, Prentice Hall of India Private limited, New Delhi.
5. Veerarajan T., (2004). Partial Differential Equations and Integral Transforms, Tata McGraw- Hill Publishing Company limited, New Delhi.
6. Farlow S. J., (2012). Partial Differential Equations for Scientists and Engineers, John Wiley sons, New York.

WEBSITE LINK

1. **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25**
2. **http://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=&course%5B%5D=Partial+differential+equations&domain%5B%5D=Physical+%26+Basic+Sciences**

Semester – II

22MMP205A **ADVANCED GRAPH THEORY** **4H –4C**

Instruction Hours/week:L:4 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- This course enables the students to learn
- The fundamental concepts in graphs and trees.
- The concept matching and perfect matching.
- The independent set and independent number and its properties
- About graph colouring and notation.
- Analyze the planarity concepts and related theorems.
- Know the concept of domination in graphs.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Apply the knowledge of graphs and trees to solve the real-life problem.
2. Study in detail about the independent sets and its properties.
3. Identify matchings and covers in graphs
4. Understanding the basic concepts of colouring, free graphs and chromatic polynomial.
5. Analyze planarity of graphs.
6. Understanding the basic concepts of dominating set and domination number.

UNIT I

CONNECTIVITY

Vertex Cuts and Edge Cuts - Connectivity and Edge - Connectivity, Trees: Definitions, Characterization and Simple Properties - Counting the Number of Spanning Trees - Cayley's Formula.

UNIT II

INDEPENDENT SETS AND MATCHINGS

Vertex Independent Sets and Vertex Coverings - Edge Independent Sets - Matchings – Matching sand Coverings in Bipartite Graphs - Perfect Matchings

UNIT III

GRAPH COLOURINGS

Vertex Coloring - Critical Graphs - Triangle - Free Graphs - Edge Colorings of Graphs - Chromatic Polynomials- Vizing's theorem.

UNIT IV

PLANARITY

Planar and Nonplanar Graphs - Euler Formula and its Consequences - K_5 and $K_{3,3}$ are Nonplanar Graphs - Dual of a Plane Graph - The Four Colour Theorem and the Heawood Five - Colour Theorem - Kuratowski's Theorem.

UNIT- V

DOMINATION IN GRAPHS

Introduction – Terminology and concepts – Applications – Dominating Set and domination number – Independent set and independent number.

TEXT BOOK

1. Balakrishnan R., and Ranganathan K., (2008) A Textbook of Graph Theory, Springer, International Edition, New Delhi.

REFERENCES

1. Bondy J. A., and Murty U. S. R., (2013). Graph Theory with Applications, Elsevier, New York.
2. Deo N., (2016). Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India Pvt Ltd, New Delhi.
3. Teresa W Haynes., Stephen T Hedetniemi., and Peter J Slater., (1998). Fundamentals of Domination in Graphs, Marcel Dekker, New York.
4. Arumugam S., Ramachandran S., (2006). Invitation to graph theory, Scitech publications, Chennai.
5. Harary F., (2001). Graph Theory, Addison- Wesley Publishing Company Inc USA.

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1.http://vidyamitra.inflibnet.ac.in/index.php/content/index/5704c5378ae36c6ab9b0b602
2.http://172.16.25.76/course/view.php?id=2085

Semester – II

22MMP205B **MODULE THEORY** **4H –4C**

Instruction Hours/week: L:4 T:0 P:0 **Marks:** Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Understand the key concepts of modules.
- The primary decomposition in Noetherian rings.
- Integral elements and integral extension.
- Concept of Valuation rings and Dedekind domains.
- The concept of local rings.
- The basics of free modules.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Investigate the properties of a ring or module
2. Identify and construct example of modules, and apply homomorphism theorems on the same.
3. Characterize Noetherian, Artinian module.
4. Connect module theory over finiteness of integral closer.
5. Understand the concept of Valuation rings.
6. Mastery in the concepts Dedekind rings.

UNIT I

MODULES

Free modules, projective modules, tensor products, flat modules.

UNIT II

LOCALIZATION

Ideals, local rings, localization, applications

UNIT III

NOETHERIAN RINGS

Noetherian modules, primary decomposition, Artininan modules, length of a module

UNIT IV

INTEGRAL EXTENSIONS

Integral elements, integral extension, integrally closed domains, finiteness of integral closure.

UNIT V

DEDEKIND DOMAINS

Valuation rings, discrete valuation rings, Dedekind domains.

TEXT BOOK

1. Gopalakrishnan. N. S. (1986), University Algebra, Wiley Eastern Ltd., New Delhi.

REFERENCES

1. Anderson. F.W. and Fuller. K.R., Rings and Categories of Modules. Springer, Verlag.
2. Lambek. J, Lectures on Rings and Modules, Blaisdell Publ. Co.
3. Golan. J. S, Modules and Structures of Rings, Marcel Dekkar Inc.

WEBSITE LINK

1. https://www.youtube.com/watch?v=HHyBTlUJyF0
2. https://www.youtube.com/watch?v=wNDOTUWFR2M

Semester –II

22MMP205C FUNDAMENTALS OF ACTUARIAL MATHEMATICS 4H–4C

Instruction Hours/week:L:4 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**
End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- How to assess the suitability of actuarial, financial and economic models in solving actuarial problems
- The fundamental theories of actuarial science as they apply in life insurance, general insurance and superannuation.
- Interpretation and critically evaluating the various values of annuities.
- About the concept of premiums annuity plan.
- Understand the Premium Conversion tables for calculation of Policy values.
- The concept of Premiums for Annuity Plans.

Course Outcomes (COs)

On successful completion of this course the students will be able to

1. Explain the basic concepts of accounts and calculations of interest rates in banking / financial institution system.
2. Describe about Premiums of Life Insurance and Endowment Assurance (Pure, Double and Marriage) and Educational Annuity plan.
3. Define Annuity and Summarize / calculate different values of Annuities.
4. Learn about annual premiums and annuity plans.
5. Find the Annuity values for various Annuities.
6. Calculation of Net Premiums for Assurance Plans.

UNIT I

BASIC CONCEPTS OF ACTUARIAL MATHEMATICS

Accumulated Value – Present Value – Formula for present value- Annuities Certain- present Values-Amounts - Deferred Annuities –Perpetuities - Present Value of an Immediate Annuity Certain–Accumulated Value of Annuity – Relation between S_n and a_n –Present Value of Deferred Annuity Certain – Accumulated Value of a term of n years – Perpetuity – Present Value of an Immediate Perpetuity of 1p.a. – Present Value of a Perpetuity due of 1 p.a. – Deferred Perpetuity with Deferment Period of m years – Mortality Table – The Probabilities of Survival and Death.

UNIT II

CALCULATION OF DIFFERENT INSURANCE PREMIUMS

Life Insurance Premiums – General considerations - Assurance Benefits – Pure Endowment Assurance – Endowment Assurance – Temporary Assurance or Term Assurance - Whole Life Assurance – Pure Endowment Assurance – Endowment Assurance – Double Endowment Assurance Increasing Temporary Assurance – Increasing Whole Life Assurance – Fixed Term (Marriage) Endowment – Educational Annuity Plan.

UNIT III

VARIOUS VALUES OF ANNUITIES

Life Annuities and Temporary Annuities – Commutation Functions Nx – To Find the Present ValueofanAnnuityDueofRe.1p.a.for Life–Temporary Immediate Life Annuity–Expression for ax : n – Deferred Temporary Life Annuity – Variable Life Annuity – Increasing Life Annuity – Variations in the Present Values of Annuities – Life Annuities Payable at Frequent Intervals.

UNIT IV

ANNUAL PREMIUMS AND ANNUITY PLANS

Net Premiums for Assurance Plans – Natural Premiums – Level Annual Premium – Symbols for Level Annual Premium under Various Assurance Plans – Mathematical Expressions for level Annual Premium under Level Annual Premium under Various Plans for Sum Assure of Re. 1 – Net Premiums – Consequences of charging level Premium – Consequences of withdrawals – Net Premiums for Annuity Plans – Immediate Annuities – Deferred Annuities.

UNIT V

POLICY VALUE AND ITS CALCULATION

Premium Conversion tables – Single Premium Conversion tables – Annual Premium Conversion Tables – Policy Values – Two kinds of Policy values – Policy value in symbols – Calculation of Policy Value for Unit Sum Assure – Other Expressions for Policy Value – Surrender Values – Paid up Policies – Alteration of Policy Contracts.

TEXT BOOK

1. Mathematical Basis of Life Insurance - Insurance Institute of India

WEB LINK

1. https://www.youtube.com/watch?v=Z95I07ZauOo
2. https://www.youtube.com/watch?v=Uun217imHhs

Semester –II

22MMP211 MATHEMATICAL STATISTICS–PRACTICAL 4H–2C

Instruction Hours/week:L:0 T:0 P:4 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- In-depth understanding of SPSS Software Package.
- It is well recognized nowadays the importance of Statistics as an indispensable tool for obtaining and spreading information.
- Importance has been enhanced by the use of computational resources and particularly the software SPSS, that showed, during the last decades, to be an effective tool for treating and analyzing statistical data.
- Ability to use SPSS procedures in handling data files and performing statistical analysis, and to interpret the outputs provided by the program.
- Acquiring sensitivity and critical thinking towards arguments and conclusions based on statistical studies.
- Understanding the fundamental principles underlying descriptive and inferential statistical reasoning.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Describe and classify data using statistical terminology.
2. Use SPSS to conduct basic descriptive analyses and graphical presentations.
3. Define the null hypothesis and the alternative hypothesis and Interpret P values and confidence intervals.
4. Understand different measures of effect (e.g. mean difference).
5. Know when to use basic statistical hypothesis tests (t-tests, chi-squared tests, correlation) and how to carry out these tests using SPSS.
6. Appreciate how to present and interpret these results in scientific reports.

List of Practical

1. Various Software Package available for Data Analytics
2. Introduction to SPSS Software Package for Data Analytics
3. Drawing of graphs and diagrams using software
4. Calculation of Standard deviation for individual and discrete series.
5. Calculation of Standard deviation continuous series.
6. Calculation of Coefficient of Variation.

7. Calculation of Karl Pearson's Correlation
8. Calculation of Rank Correlation Coefficient
9. Fitting of Linear Regression
10. Hypothesis Testing for small sample test (t - test)
11. Hypothesis Testing for two sample t -test
12. Hypothesis Testing for Large sample(Z-test)
13. Testing Hypothesis using chi-square - test (for Goodness off it)
14. Testing Hypothesis using chi-square - test (for Contingency Table)

REFERENCES

1. SPSS Lab Manual
2. U Dinesh Kumar., (2017). Business Analytics: The Science of Data - Driven Decision Making, Wiley, New Delhi.
3. Daniel Y Chen., (2017). Pandas for everyone - Python data Analysis,
4. Evans James R., (2017), Business Analytics, 2nd edition, Pearson Education, New Delhi.

Semester – III

22MMP301 **TOPOLOGY** **5H –5C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The concepts of metric spaces and topological spaces.
- Topological properties of sets.
- The properties of connected spaces local connectedness.
- The foundations of compact spaces and compact subspace.
- Metrizability of topological spaces.
- Interior, closure and boundary applications in geographic information systems.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Understand concept of metric spaces.
2. Acquire knowledge about various types of topological spaces and product topologies.
3. Discuss components and local connectedness.
4. Know the result of Compactness problems and theorems.
5. Create examples and counterexamples in the fundamental concepts of separation space.
6. Develop their abstract thinking skills on topological concepts.

UNIT I

TOPOLOGY OF METRIC SPACES

Topological spaces-Basis for a topologies-The order topology-The product topology $X \times Y$-The subspace topology.

UNIT II

TOPOLOGICAL PROPERTIES

Closed set and limit points-Continuous functions-The product topologies-The metric topologies.

UNIT III

CONNECTEDNESS

Connected spaces-Connected subspaces of the real line-Components and local connectedness.

UNIT IV

COMPACTNESS

Compact spaces-Compact subspaces of the Real line-Limit point compactness-Local compactness.

UNIT V

COUNTABILITY AND SEPARATION AXIOMS

The countability axioms-The separation axioms-Normal spaces-The Urysohn lemma, The Urysohn metrization theorem-The Tietze Extension theorem.

TEXT BOOK

1. James Munkres R., (2008). Topology, Second edition, Pearson Prentice Hall, New Delhi.

REFERENCES

1. Simmons G. F., (2017). Introduction to Topology and Modern Analysis, Tata McGraw Hill, New Delhi.
2. Deshpande J. V., (1990). Introduction to topology, Tata McGraw Hill, New Delhi.
3. James Dugundji., (2002). Topology, Universal Book Stall, New Delhi.
4. Joshi K. D., (2017). Introduction to General Topology, New Age International Pvt Ltd, New Delhi.

WEBSITE LINK

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25
2. https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/index.htm
3. http://vidyamitra.inflibnet.ac.in/index.php/content/index/5a5dcf758007be2bd1bc30b
4. http://172.16.25.76/course/view.php?id=1170

Semester – III

22MMP302 **COMPLEX ANALYSIS** **5H –5C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The concepts of oriented circles and level curves.
- Fundamental concepts of complex integration.
- Primary facts about harmonic function.
- About Stirling's Formula and Jensen's formula.
- The development of the complex variable in boundary behaviour.
- The fundamental theorem of calculus and Cauchy's integral formula.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Explain the role of the Conformal mapping.
2. Evaluate complex contour integrals and some of their consequences.
3. Determine the Taylor series or the Laurent series of an analytic function in a given region
4. Describe the convergence properties of a power series.
5. Know the basic properties of singularities of analytic functions.
6. Demonstrate familiarity with a range of examples of these concepts of conformal mapping.

UNIT I

CONFORMALITY

Conformal mapping-Linear transformations- cross ratio- symmetry- Oriented circles-families of circles-level curves.

UNIT II

FUNDAMENTAL THEOREMS

Complex integration - rectifiable Arcs- Cauchy's theorem for Rectangle and disc - Cauchy's integral formula - higher derivatives.

UNIT III

HARMONIC FUNCTIONS

Harmonic functions - mean value property-Poisson's formula-Schwarz theorem, Reflection principle-Weierstrass theorem- Taylor series and Laurent series.

UNIT IV

PARTIAL FRACTIONS

Partial Fractions- Infinite products – Canonical products-The gamma function – Stirling's Formula – Entire functions – Jensen's formula.

UNIT V

THE RIEMANN MAPPING THEOREM

Riemann Mapping Theorem – Boundary behavior – Use of Reflection Principle – Analytical arcs
– Conformal mapping of polygons- The Schwartz – Christoffel formula.

TEXT BOOK

1. Lars Ahlfors.V., (2017). Complex Analysis, Third edition, Mc-Graw Hill Book Company, New Delhi.

REFERENCES

1. Ponnusamy S., (2019). Foundation of Complex Analysis, Second edition, Narosa publishing house, New Delhi.
2. Choudhary B., (2005). The Elements of Complex Analysis, New Age International Pvt. Ltd, New Delhi.
3. Vasishtha A. R., (2014). Complex Analysis, Krishna Prakashan Media Pvt. Ltd., Meerut.
4. Walter Rudin., (2017). Real and Complex Analysis, 3rd edition, McGraw Hill Book Company, New York.

WEBSITES LINK:

1. https://nptel.ac.in/courses/111107056/
2. https://nptel.ac.in/courses/111103070/
3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25

Semester – IV

22MMP303 **FUNCTIONAL ANALYSIS** **5H –5C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

1 The concept of Banach spaces and related properties.
2 Open mapping and closed graph theorems.
3 The specific techniques for bounded operators over normed and Hilbert spaces.
4 Significant applications of the theory of operators.
5 The properties of Banach algebra.
6 Applications of spectral analysis in integral equations.

Course Outcomes (COs)

On successful completion of this course, the students will be able to:

1. Develop Banach spaces from vector spaces.
2. Describe the open mapping theorem.
3. Discuss Hilbert spaces and its properties.
4. Study in detail about the adjoint of an operator.
5. Handle complex problems concerning topics within the area of regular and singular elements.
6. Understand and apply fundamental theorems of normed and Banach spaces.

UNIT I

BANACH SPACES

Banach Spaces–Normed linear space – Definitions and Examples-Theorems. Continuous Linear Transformations–Some theorems - Problems. The Hahn-Banach Theorem – Lemma and Theorems. The Natural imbedding of N in N**–Definitions and Theorems.

UNIT II

OPEN MAPPING THEOREM

The Open Mapping Theorem– Theorem and Examples –Problems. The closed graph theorem. The conjugate of an operation–The uniform boundedness theorem–Problems.

UNIT III

HILBERT SPACES

The Definition and Some Simple Properties – Examples and Problems. Orthogonal Complements – Some theorems. Ortho-normal sets– Definitions and Examples-Bessel's inequality – The conjugate space H*.

UNIT IV

THE ADJOINT OF AN OPERATOR

Definitions and Some Properties–Problems. Self-adjoint operators – Some Theorems and Problems. Normal and Unitary operators –theorems and problems. Projections –Theorems and Problems.

UNIT V

BANACH ALGEBRAS

Matrices–Determinant and Spectrum of bounded operator–The spectral Theorem–The definition and some examples of Banach algebra – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius.

TEXT BOOK

1. Balmohan V., and Limaye., **(**2014). Functional Analysis, Second edition, New Age International Pvt. Ltd, Chennai.

REFERENCES

1. Simmons G. F., (2015). Introduction to Topology & Modern Analysis, Tata Mc Graw-Hill Publishing Company Ltd, New Delhi.
2. Chandrasekhara Rao K., (2006). Functional Analysis, Second edition, Narosa Publishing House, Chennai.
3. Choudhary B., and Sundarsan Nanda., (2003). Functional Analysis with Applications, New Age International Pvt. Ltd, Chennai.
4. Ponnusamy S., (2002). Foundations of functional analysis, Narosa Publishing House, Chennai.

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1. https://ocw.mit.edu/courses/mathematics/18-102-introduction-to-functional-analysis-spring-2009/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25
3. http://vidyamitra.inflibnet.ac.in/index.php/content/index/5704c5378ae36c6ab9b0b5bf
4. http://vidyamitra.inflibnet.ac.in/index.php/content/index/5704c5378ae36c6ab9b0b5a9
5. http://172.16.25.76/course/view.php?id=1652

		Semester – III
22MMP304	**FLUID DYNAMICS**	**5H –5C**

Instruction Hours/week:L:5 T:0 P:0	**Marks:**Internal:**40**	External: **60** Total:**100**
		End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The concepts of fluid, its properties and behavior under various conditions of internal and external flows.
- The fundamentals of Fluid Dynamics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
- About the Two-Dimensional Motion of the fluid.
- Vorticity and circulation in a viscous fluid.
- Identify the fundamental kinematics of a fluid element.
- State the conservation principles of mass, linear momentum, and energy for fluid flow.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Classify and exploit fluids based on the physical properties of a Stream Lines and Path Lines.
2. Apply the conservation principles of mass, linear momentum, and energy to fluid flow systems.
3. Understand the concepts of two dimensional motions and lift forces of a fluid element.
4. Understand both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution.
5. Provide the basic mathematical background and tools to boundary layer concepts.
6. Calculate the flow of an ideal fluid in a variety of situations.

UNIT I

INTRODUCTORY NOTIONS

Introductory notions-Velocity – Stream Lines and Path Lines – Stream Tubes and Filaments – Fluid Body – Density – Pressure. Differentiation with respect to the time Differentiation following the Fluid – Equation of continuity – Boundary conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an inviscid fluid.

UNIT II

EQUATION OF MOTION OF A FLUID

Euler's momentum Theorem – Conservative forces – Bernoulli's theorem in steady motion – Energyequationforinviscidfluid–Circulation–Kelvin'stheorem–Vortexmotion–Helmholtz equation.

UNIT III

TWO-DIMENSIONAL MOTION

Two Dimensional Functions: Stream function- Velocity potential-Complex potential- Indirect approach-Inverse function. Basic singularities: Source – Sink- Vortex- Doublet-Method of images. Circle theorem- Flow past a circular cylinder with circulation. The aerofoil: Blasius Theorem – Lift force. (Magnus effect)

UNIT IV

VISCOUS FLOWS

flows – Navier-Stokes equations – Vorticity and circulation in a viscous fluid – Steady flow through an arbitrary cylinder under pressure – Steady Couettc flow between cylinders in relative motion – Steady flow between parallel planes.

UNIT V

LAMINAR BOUNDARY LAYER IN INCOMPRESSIBLE FLOW

Boundary Layer concept – Boundary Layer equations – Displacement thickness, Momentum thickness–Kinetic energy thickness–Integral equation of boundary layer–Flow parallel to semi-infinite flat plate – Blasius equation and its solution in series.

TEXT BOOKS

1. Milne Thomson L. M., (2011). Theoretical Hydrodynamics, Fifth edition, Dover Publications INC, New York.
2. Curle N., and Davies H.J., (1971). Modern Fluid Dynamics Volume-I , D Van Nostrand Company Ltd., London.

REFERENCES

1. Yuan S.W., (1988). Foundations of Fluid Mechanics, Prentice- Hall, New Delhi.
2. Shanthiswarup., (2019). Fluid dynamics, Krishna Prakasan media Pvt Ltd, Meerut.

WEBSITE LINK

1. https://ocw.mit.edu/courses/mechanical-engineering/2-06-fluid-dynamics-spring- 2013/
2. http://172.16.25.76/course/view.php?id=2086

Semester –III

22MMP305A FUZZY SETS AND FUZZY LOGIC 5H –5C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The basic knowledge of fuzzy sets.
- Momentous properties of fuzzy relations.
- Basic fuzzy relation equations.
- The basic concepts of modeling in systems using possibility theory.
- Applications of fuzzy logic.
- The importance of tolerance of imprecision and uncertainty for design of robust &low cost intelligent machines.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Differentiate crisp sets and fuzzy sets.
2. Understand the concepts of fuzzy relations.
3. Attain mastery in fuzzy relations equations.
4. Understand the fundamental concepts of possibility theory.
5. Apply fuzzy concepts in decision making.
6. Understand the concept of fuzzy measures.

UNIT I

CRISP SETS AND FUZZY SETS

Introduction-Crisp sets: An over view-The Notion of Fuzzy Sets-basic concepts of Fuzzy sets. Classical Logic: complement-Fuzzy Union-Fuzzy interaction – Combination of operations– general aggregation of operations.

UNIT II

FUZZY RELATIONS

Crisp and Fuzzy relations – Binary relations – Binary relations on a single set – Equivalence and similarity relations – Compatibility on Tolerance Relations-Orderings – Morphism – fuzzy relations Equations.

UNIT III

FUZZY RELATION EQUATIONS

General Discussion, Problem Partitioning, Solution Method, Fuzzy Relation Equations Based on Sup-i Compositions, Fuzzy Relation Equations Based on Inf-w_iCompositions, Approximate Solutions, The Use of Neural Networks

UNIT IV

POSSIBILITY THEORY

Possibility Theory, Fuzzy Sets and Possibility Distributions, Possibility and Necessity Measures

Probability of Fuzzy Events, Probability of a Fuzzy Event as a Scalar, Probability of a Fuzzy Event as a Fuzzy Set, Possibility vs. Probability

UNIT V

FUZZY LOGIC

Classical Logic: An Overview, Multi valued Logics, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic, Hedges, Inference from Conditional Fuzzy Propositions, Inference from Conditional and Qualified, Propositions, Inference from Quantified Propositions.

TEXT BOOK

1. George J Klir., and Tina A Folger., (2015). Fuzzy Sets, Uncertainty and Information, pearson publications.

REFERENCES

1. George J Klir., and Bo Yuan., (2008). Fuzzy Sets and Fuzzy Logic, Prentice Hall of India.
2. Zimmerman. H. J., (2006). Fuzzy Set Theory and Its Applications, Kluwer Academic publishers.
3. DuBois D., and Prade H. M., (1994). Fuzzy Sets and Systems: Theory and Applications, Academic Press.
4. Ross T. J., (2016). Fuzzy Logic with Engineering Applications,4th edition, Willey Publications.

WEBSITE LINK

1. https://youtu.be/BFEwuFatM4Q.
2. http://videolectures.net/acai05_berthold_fl/

Semester – III

22MMP305B CONTROL THEORY 5H –5C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The concepts of observability and non-linear systems.
- The basic principles underlying the analysis and designing of control systems.
- The Stability and Uniform stability.
- The basic concepts of Stabilizability**.**
- The concepts Linear time invariant systems and Nonlinear Systems.
- How the problem of finding a control law for a given system.

Course Outcomes (COs)

On successful completion of the course, the students will be able to:

1. Understand the control theory concepts and properties including observability.
2. Apply the concept of controllability in state models.
3. Explain stability and asymptotic stability of linear systems.
4. Familiarize with Stabilization via linear feedback control – Bass method.
5. Find a control law for a given system.
6. Purview on the concept of control theory.

UNIT-I

OBSERVABILITY

Linear Systems – Observability Grammian – Constant coefficient systems –Reconstruction kernel – Nonlinear Systems.

UNIT-II

CONTROLLABILITY

Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems– Steering function – Nonlinear systems.

UNIT-III

STABILITY

Stability – Uniform stability – Asymptotic stability of linear systems - Linear time-varying systems – Perturbed linear systems – Nonlinear systems.

UNIT-IV

STABILIZABILITY

Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback.

UNIT-V

OPTIMAL CONTROL

Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems.

TEXT BOOK

1. Balachandran K., and Dauer J. P., (2012). Elements of Control Theory, Narosa Publishing House, New Delhi.

REFERENCES

1. Conti R., (1976). Linear Differential Equations and Control, Academic Press, London.
2. Curtain.R.F and Pritchard.A.J., (1977). Functional Analysis and Modern Applied Mathematics, Academic Press, New York.
3. Klamka. J., (2018). Controllability and Minimum Energy Control Kluwer Academic Publisher, Dordrecht.
4. Roger W Brockett., (2015). Finite Dimensional Linear Systems, Siam, New York.

WEBSITE LINK

1. https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/
2. https://www.youtube.com/playlist?list=PLRWKj4sFG7-6_Xr9yqg6SMr_F80KdFVhN

Semester – III

22MMP305C **NEURAL NETWORKS** **5H –5C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- The neural networks for classification and regression
- The design methodologies for neural networks
- About the multi-layer perceptron.
- The introduction and different architectures of Back propagation Algorithm.
- The fundamental concepts of optimization in neural networks.
- Tto develop and train radial-basis function networks.

Course Outcomes (COs)

On successful completion of this course the students will be able to

1. Comprehend the concepts of feed forward neural networks
2. Analyze the various Linear Associator.
3. Design single and multi-layer feed-forward neural networks
4. Analyze the various Back Propagation Algorithm
5. Supervised learning and unsupervised learning.
6. Analyze the performance of neural networks in directional derivatives.

UNIT I

EVOLUTION OF NEURAL NETWORKS

Mathematical Neuron Model- Network Architectures- Perceptron-Hamming Network- Hopfield Network-Learning Rules.

UNIT II

PERCEPTRON LEARNING RULE

Perceptron Architectures and Learning Rule with Proof of Convergence. Supervised Hebbian Learning -Linear Associator.

UNIT I III

MULTI-LAYER PERCEPTRONS

The Hebb Rule-Pseudo inverse Rule-Variations of Hebbian Learning-Back Propagation - Multilayer Perceptrons.

UNIT IV

BACK PROPAGATION

Back propagation Algorithm-Convergence and Generalization–Performances Surfaces and Optimum Points-Taylor series.

UNIT V

OPTIMITATION IN NEURAL NETWORK

Directional Derivatives - Minima-Necessary Conditions for Optimality-Quadratic Functions-Performance Optimizations-Steepest Descent-Newton's Method-Conjugate Gradient.

TEXT BOOK

1. Martin T Hagan., Howard B Demuth., and Mark Beale., (2014). Neural Network Design, Vikas, Publishing House, New Delhi.

REFERENCES

1. James A Freeman., and David M Skapura., (2011). Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education.
2. Robert J Schalkoff., (2000). Artificial Neural Network, McGraw-Hill International Edition.

WEBSITE LINK

1. https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-641j-introduction-to-neural-networks-spring-2005/
2. https://www.youtube.com/watch?v=xbYgKoG4x2g&list=PL53BE265CE4A6C056

Semester – III

22MMPOE301 **CODING THEORY** **3H –2C**

Instruction Hours/week:L:3 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- Elements of coding theory and its applications.
- Understand the concept of bounds in coding theory.
- About the encoding and decoding.
- Analyze the concept of cyclic coding
- Acquiring the knowledge special cyclic codes.
- The concept of Communication channels.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Recognize the basic concepts of coding theory.
2. Understand the importance of finite fields in the design of codes.
3. Detect and correct the errors occur in communication channels with the help of methods of coding theory.
4. Apply the tools of linear algebra to construct special type of codes.
5. Use algebraic techniques in designing efficient and reliable data transmission methods.
6. Know the concept of error detection, correction.

UNIT 1: ERROR DETECTION, CORRECTION AND DECODING:

Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhood minimum distance decoding – Distance of a code.

UNIT 2: LINEAR CODES

Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.

UNIT 3: BOUNDS IN CODING THEORY:

The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.

UNIT 4: CYCLIC CODES:

Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

UNIT 5: SPECIAL CYCLIC CODES:

BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

TEXT BOOK

1. San Ling and Chaoping Xing (2004). Coding Theory: A first course, Cambridge University Press.

REFERENCES

1. Lin. S & Costello. D. J. (1983). Jr., Error Control Coding: Fundamentals and Applications, Prentice-Hall, Inc., New Jersey.
3. Vera Pless (1982). Introduction to the Theory of Error Correcting Codes, Wiley, New York.
4. Berlekamp E.R. (1968). Algebriac Coding Theory, Mc Graw-Hill.
5. H. Hill (1986). A First Course in Coding Theory, OUP.

22MMP391	**INTERNSHIP**	**Semester – III –2C**
Instruction Hours/week:L:0 T:0 P:0	**Marks:**Internal:100	External: Total:**100**

Semester – IV

22MMP401 **OPERATOR THEORY** **5H –4C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The concepts of bounded linear operators and partial isometry operators.
- The concepts of polar decomposition, spectrum and numerical range of an operator.
- The properties of several classes of non-normal operators
- Development of bounded linear operators.
- Various kinds of new operators.
- Important properties of projection operators

Course Outcomes

On successful completion of this course, the students will be able to

1. Understand the properties of bounded linear operators.
2. Understand the concepts of polar decomposition spectrum and numerical range of an operator.
3. Understand the spectrum of an operator and their kinds
4. Understand the properties of several classes of non-normal operators and further development of bounded linear operators.
5. Understand different types of new operators.
6. Mastery in polar decomposition.

UNIT I

BOUNDED LINEAR OPERATORS ON A HILBERT SPACE

Norm of bounded linear operator – Adjoint operators – Generalized polarization identity and its applications – Several properties on projection operator- Generalized Schwarz inequality and square root of positive operator.

UNIT II

PARTIAL ISOMETRY OPERATOR AND POLAR DECOMPOSITION OF AN OPERATOR

Characterization of Partial Isometry operator – Polar decomposition – Invariant subspace and reducing subspace – A necessary and sufficient condition for $\boldsymbol{T_1T_2 = T_2T_1}$ and $\boldsymbol{T_1T_2^* =}$

$T_2^* T_1$ - Polar decomposition of non-normal operator.

UNIT III

SPECTRUM OF AN OPERATOR

Two kinds of classifications of spectrum– Spectral Mapping Theorem – Numerical range is a convex set –Numerical radius is equivalent to operator norm- The closure of numerical range includes the spectrum- Normaloid and Spectraloid operator.

UNIT IV

RELATIONS AMONG SEVERAL CLASSES OF NON-NORMAL OPERATORS

Paranormal operator - characterizations of Convexoid operators – Young Inequality and generalized operator means – Holder – McCarthy inequality and Furuta inequality-Statement of generalized Furuta inequality (without proof)

UNIT V

ALUTHGE TRANSFORMATION ON P-HYPONORMAL OPERATOR

Aluthge Transformation on log- hyponormal operators – Asubclass of paranormal operators including log- hyponormal operators – Several classes related to class A and paranormal operators – A Further extension of theorem – 1 – An absolute k-paranormal operator is normaloid – Characterizations of absolute k paranormal operators.

TEXT BOOK

1. Takayuki Furuta, “Invitation to Linear Operators” Taylor & Francis. 2001.

REFERENCES

1. Berberian S. K, “Lectures in Functional Analysis and operator theory” Springer-Verlag, Newyork, 1979.
2. Abranovich Y.A “Problems in operator theory”, American Mathematical Society, Hyderabad, 2013.

WEBSITE LINK

1. **https://www.youtube.com/watch?v=x94R4D2GeFg**
2. **https://www.youtube.com/watch?v=P8eneFsTvyo**

Semester – IV

22MMP402 MATHEMATICAL METHODS 5H –4C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**

End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- Range of mathematics tools with emphasis on engineering applications.
- To think quantitatively and analyse problems critically.
- The concept of Volterra integral and Fredholm theory.
- Fundamentals of integral equations for ordinary differential equations.
- The concepts of functional dependent on higher order derivatives.
- About the variation and its properties.
- To develop mathematical curiosity and use inductive and deductive reasoning when solving problems.

Course Outcomes (COs)

On successful completion of this course, the students will be able to

1. Calculate the Integral equations of elementary functions from the definition.
2. Find the Volterra integral equation for Fredholm theory.
3. Understand the concepts of integral equations and its types.
4. Equation with boundary value problems and singular integral equations.
5. Find the solution by using variation methods.
6. Understand the concept of functionals of the integral forms.

UNIT I

INTEGRAL EQUATIONS

Types of Integral equations–Equation with separable kernel- Fredholm Alternative Approximate method–Volterra integral equations – Classical Fredholm theory Fredholm's First, Second, Third theorems.

UNIT II

INTEGRAL EQUATIONS

Conversion of ordinary differential equation into integral equation - Method of converting initial value problem into a Volterra integral equation - Boundary value problem - Method of converting a boundary value problem into a Fredholm integral equation.

UNIT III

INTEGRAL EQUATIONS FOR ORDINARY DIFFERENTIAL EQUATIONS

Application of Integral equation to ordinary differential equation – initial value problems – Boundary value problems – singular integral equations – Abel Integral equation- The solution of Abel's integral equation – Some general form of Abel's singular integral equation - Problem- Applications of integral equation and Green's functions to ordinary differential equation.

UNIT IV

VARIATIONAL PROBLEMS WITH FIXED BOUNDARIES

Variation and its properties – Euler's equation – Functionals of the integral forms - Functional dependent on higher order derivatives – functionals dependent on the functions of several independent variables – variational problems in parametric form.

UNIT V

VARIATIONAL PROBLEMS WITH MOVING BOUNDARIES

Variational problems with moving boundaries - Variational problems with moving boundaries for a functional dependent on two functions – one sided variations.

TEXT BOOKS

1. Sneedon I. N., (1974). The Use of Integral Transforms, Tata McGraw Hill,New Delhi.
2. Gupta. A.S., (2008). Calculus of Variations with Applications, Prentice Hall, India.

REFERENCES

1. Raisingahania.M.D. (2015). Advanced Differential equations, S. Chand & Company Pvt. Ltd., New Delhi.
2. Kanwal R. P., (2013). Linear integral Equations Theory and Technique, Academic press, NewYork.
3. Elsgots.L.,(2003).DifferentialEquationsandCalculusofVariation,MirPublication Moscow.
4. Gelfand.I. M., and Francis S.V., (2000). Calculus of Variation, Prentice Hall,India.
5. Tricomi.F.G., (2012). Integral Equations, Dover, New York.
6. Srivastava.A.N., and Mohammad Ahmad., (2012). Integral Transforms and Fourier Series, Alpha Science International, Limited.

WEBSITE LINK

1. http://vidyamitra.inflibnet.ac.in/index.php/content/index/570b7b068ae36c5432d66dbb
2. http://vidyamitra.inflibnet.ac.in/index.php/content/index/570b7b068ae36c5432d66dcd
3. http://172.16.25.76/course/view.php?id=1657

Semester – IV

22MMP403 STOCHASTIC PROCESSES 5H –4C

Instruction Hours/week:L:5 T:0 P:0 **Marks:**Internal:**40** External: **60** Total:**100**
End Semester Exam:3Hours

Course Objectives

This course enables the students to learn

- The mathematical theory of random variables and random processes
- The essential mathematical tools for handling Markov processes.
- Markov processes in discrete and continuous time.
- The theoretical concepts and techniques for solving problems that arises in branching processes.
- Applications of queueing models in the study of networks.
- The stochastic simulation techniques.

Course Outcomes (COs)

On successful completion of the course, students will be able to:

1. Acquire in dept knowledge about stochastic models.
2. Application of birth and death process in random models.
3. Proficient in Markov process with continuous state space.
4. Attain working knowledge in branch processes.
5. Proficient in solving stochastic queueing models.
6. Attain mastery in Markov models with their applications.

UNIT I

STOCHASTIC PROCESSES

Definition of Stochastic Processes–Markov chains: definition, order of a Markov Chain–Higher transition probabilities – Classification of states and chains.

UNIT II

MARKOV PROCESS WITH DISCRETE STATE SPACE

Poisson process – and related distributions – Properties of Poisson process, Generalizations of Poisson Processes – Birth and death Processes – continuous time Markov Chains.

UNIT III

MARKOV PROCESSES WITH CONTINUOUS STATE SPACE

Introduction, Brownian motion – Weiner Process and differential equations for Weiner process, Kolmogrov equations–First passage time distribution for Weiner process–Ornstein–Uhlenbech process.

UNIT IV

BRANCHING PROCESSES

Introduction – properties of generating functions of Branching process– Distribution of the total number of progeny, Continuous- Time Markov Branching Process, Age dependent branching process: Bellman-Harris process.

UNIT V

STOCHASTIC PROCESSES IN QUEUING SYSTEMS

Concepts–Queuing model M/M/1–transient behavior of M/M/1model–Birth and death process in Queuing theory: M/M/1 – Model related distributions – M/M/1 - M/M/S/S – loss system - M/M/S/M – Non birth and death Queuing process: Bulk queues –M(x)/M/1.

TEXT BOOK

1. Medhi J., (2019). Stochastic Processes, Fourth edition, New age international Private limited, New Delhi.

REFERENCES

1. Basu K., (2003). Introduction to Stochastic Process, Narosa Publishing House, New Delhi.
2. Goswamiand Rao B. V., (2006). A Course in Applied Stochastic Processes, Hindustan Book Agency, New Delhi.
3. Grimmett G., and Stirzaker D., (2001). Probability and Random Processes, 3rd Ed., Oxford University Press, New York.
4. Papoulis A., and Unnikrishna Pillai., (2017). Probability, Random variables and Stochastic Processes, Fourth Edition, McGraw-Hill, New Delhi.
5. Sundarapandian V., (2009). Probability statistics and Queuing theory, PHI learning private limited, New Delhi.

WEBSITE LINK

1. https://ocw.mit.edu/courses/mathematics/18-445-introduction-to-stochastic-processes-spring-2015/
2. http://172.16.25.76/course/view.php?id=2070

		Semester – IV
22MMP491	PROJECT	–8C
Instruction Hours/week:L:0 T:0 P:0	Marks:Internal:80	External:120 Total:200
		End Semester Exam: -

LIST OF VALUEADDED COURSES

- Data Analysis using SPSS
- LATEX
- Vedic Mathematics
- MATLAB
- MAPLE
- GEOGEBRA
- DIA
- Data Analysis Using Advanced Excel
- Mathematical Modelling with Excel
- Productivity Analysis and Audit
- Data Analysis Using R Programming
- Statistical Quality Control
- Six Sigma Analysis