Dr. N.G.P. ARTS AND SCIENCE COLLEGE

(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore)
Approved by Government of Tamil Nadu and Accredited by NAAC with 'A++' Grade (3rd Cycle-3.64 CGPA)
Dr. N.G.P. – Kalapatti Road, Coimbatore-641048, Tamil Nadu, India
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REGULATIONS 2023-24 for Post Graduate Programme
(Outcome Based Education model with Choice Based Credit System)
M.Sc. Mathematics Degree

(For the students admitted during the academic year 2023-24 and onwards)

Programme: M.Sc. Mathematics

Eligibility:

A candidate who has passed the Degree Examination in B.Sc. (Mathematics) or B.Sc. (Mathematics with Computer Applications) of Bharathiar University and as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the **Master of Science in Mathematics** Degree Examination of this College after a course of study of two academic years

Programme Educational Objectives:

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To meet the demand for well trained Post Graduates in Mathematics with academic Excellence.
2. To demonstrate an understanding of the theoretical concepts and axiomatic underpinnings of Mathematics and an ability to construct proofs at the appropriate level.
3. To demonstrate competency in Mathematical modeling of complex phenomena, problem solving and decision making.
4. To demonstrate a level of proficiency in quantitative and computing skills sufficient to meet the growing demands of society upon modern education.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expectedoutcomes.

PO Number	PO Statement
PO1	Students will have knowledge, understanding and Mathematical thinking of the basic and advanced concepts, techniques from different topics
PO2	They have a fundamental and advanced understanding of at least one Mathematical topic of their choice and able to solve problem related to the topic
PO3	They can be able to communicate clearly in writing and orallying the detailed technical arguments of complex Mathematical concepts
PO4	The students develop problem solving skill and apply them independently to problems in pure and applied Mathematics
PO5	They can develop the knowledge of formulating, analyzing and problem solving in core areas of the Mathematics including Analysis, Algebra and Statistics

PG Credit Distribution:

Part	Subjects	No. of Papers	Credit	Semester No.
III	Core	16	13 x 04 = 52 02 x 03 = 06 01 x 05 = 05	I - IV
	Elective	04	04 x 04 = 16	I - IV
	EDC	01	01 x 03 = 03	II
	Industrial Training	01	01 x 02 = 02	III
	Project Work	01	01 x 08 = 08	IV
TOTAL CREDITS			**92**	-

PG
CURRICULUM

M.Sc. MATHEMATICS – AY 23-24

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
232MT2A1CA	Core – I	Algebra	4	1	-	3	25	75	100	4
232MT2A1CB	Core – II	Advanced Analysis	4	2	-	3	25	75	100	4
232MT2A1CC	Core – III	Ordinary Differential Equations	4	1	-	3	25	75	100	4
232MT2A1CD	Core - IV	Operations Research	4	1	-	3	25	75	100	4
232MT2A1CE	Core - V	Advanced Statistics	3	2	-	3	25	75	100	3
232MT2A1DA	DSE -I	Numerical Analysis	4	-	-	3	25	75	100	4
232MT2A1DB		Commutative Algebra								
232MT2A1DC		Mathematical Modeling								
		Total	**23**	**7**					**600**	**23**

BoS Chairman/HoD
Department of Mathematics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Scien... Cr
APPROVED

BoS- 15th	AC - 15th	GB - 20th
12.06.23	14.07.23	05.08.23

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
232MT2A2CA	Core - VI	Complex Analysis	4	1	-	3	25	75	100	4
232MT2A2CB	Core - VII	Topology	4	1	-	3	25	75	100	4
232MT2A2CC	Core - VIII	Partial Differential Equations	4	1	-	3	25	75	100	4
232MT2A2CP	Core -IX	Computational Mathematics	3	-	4	3	40	60	100	5
232MT2A2EB	EDC	Foundations of Data Analytics	3	1	-	3	25	75	100	3
232MT2A2DA	DSE -II	Wavelet Analysis	4	-	-	3	25	75	100	4
232MT2A2DB		Information and Coding Theory								
232MT2A2DC		Mathematical Finance								
		Total	**22**	**4**	**4**				**600**	**24**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
232MT2A3CA	Core - X	Functional Analysis	4	1	-	3	25	75	100	4
232MT2A3CB	Core - XI	Classical Mechanics	3	2	-	3	25	75	100	3
232MT2A3CC	Core - XII	Stochastic Differential Equations	4	2	-	3	25	75	100	4
232MT2A3CD	Core -XIII	Advanced Graph Theory	4	1	-	3	25	75	100	4
232MT2A3CE	Core - XIV	Fluid Dynamics	4	1	-	3	25	75	100	4
232MT2A3CT	IT	Industrial Training	-	-	-	-	40	60	100	2
232MT2A3DA	DSE -III	Finite Element Theory	4	-	-	3	25	75	100	4
232MT2A3DB		Algebraic Number Theory								
232MT2A3DC		Actuarial Mathematics								
		Total	**23**	**7**	**-**				**700**	**25**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
232MT2A4CA	Core – XV	Mathematical Methods	4	1	-	3	25	75	100	4
232MT2A4CB	Core – XVI	Distribution Theory	4	1	-	3	25	75	100	4
232MT2A4CV	Core – XVII	Project	-	-	16	3	80	120	200	8
232MT2A4DA	DSE -IV	Boundary Layer Theory	4	-	-	3	25	75	100	4
232MT2A4DB		Lie Algebra								
232MT2A4DC		Mathematical Ecology								
Total			**12**	**2**	**16**				**500**	**20**
***Grand Total**									2400	92

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I to IV

Semester I (Elective I)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	232MT2A1DA	Numerical Analysis
2.	232MT2A1DB	Commutative Algebra
3.	232MT2A1DC	Mathematical Modeling

Semester II (Elective II)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	232MT2A2DA	Wavelet Analysis
2.	232MT2A2DB	Information and Coding Theory
3.	232MT2A2DC	Mathematical Finance

Semester III (Elective III)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	232MT2A3DA	Finite Element Theory
2.	232MT2A3DB	Algebraic Number Theory
3.	232MT2A3DC	Actuarial Mathematics

Semester IV (Elective IV)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	232MT2A4DA	Boundary Layer Theory
2.	232MT2A4DB	Lie Algebra
3.	232MT2A4DC	Mathematical Ecology

EXTRA CREDIT COURSES

Self-study paper offered by the Mathematics Department

S. No.	Course Code	Course Title
1.	232MT2ASSA	Research Methodology, IPR and Entrepreneurship
2.	232MT2ASSB	Mathematics of Bioinformatics

PG REGULATION (R5)

(2023-24 and onwards)

(OUTCOME BASED EDUCATION WITH CBCS)

Effective from the academic year 2023-24 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

1.NOMENCLATURE

1.1 Faculty: Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications, Cognitive Systems, Artificial Intelligence and Machine Learning and Cyber Security and Data Analytics etc.

1.2 Programme: Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

1.3 Batch: Refers to the starting and completion year of a programme of study. Eg. Batch of 2023–2025 refers to students belonging to a 2-year Degree programme admitted in 2023 and completing in 2025.

1.4 Course: Refers to component of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

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

b) Extra Departmental Course (EDC): A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.

c) Discipline Specific Elective Course (DSE): Elective courses are offered under main discipline/ subject of study.

d)Internship/Industrial Training (IT)

Students must undertake industrial / institutional training for a minimum of 15 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

e) Project Work: It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

f) Extra credits Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

g) Advanced Learner Course (ALC): ALC is doing work of a higher standard than usual for students at that stage in their education. Research work / internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

2. STRUCTURE OF PROGRAMME

- Core Course
- Extra Departmental Course (EDC)
- Discipline Specific Elective (DSE)
- Industrial Training (IT)
- Project

3. DURATION OF THE PROGRAMME

M.Sc. /M.Com. / M.A. Programme must be completed within 2 Years (4 semesters) and maximum of 4 Years (8 semesters) from the date of acceptance to the programme. If not, the candidate must enroll in the course determined to be an equivalent by BoS in the most recent curriculum recommended for the Programme.

4. REQUIREMENTS FOR COMPLETION OF A SEMESTER

Every student shall ordinarily be allowed to keep terms for the given semester in a program of his/ her enrolment, only if he/ she fulfills at least seventy five percent (75%) of the attendance taken as an average of the total number of lectures, practicals, tutorials, etc. wherein short and/or long excursions/field visits/study tours organised by the college and supervised by the faculty as envisaged in the syllabus shall be

credited to his attendance. Every student shall have a minimum of 75% as an overall attendance.

5. EXAMINATIONS

The end semester examinations shall normally be conducted after completing 90 working days for each semester. The maximum marks for each theory and practical course as follows,

Mark distribution for Theory Courses

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 Marks

Total : 100 Marks

i) Distribution of Internal Marks

S.No.	Particulars	Distribution of Marks
1	CIA I (2.5 Units) (On completion of 45th working day)	5
2	Model (All 5 Units) (On completion of 85th working day)	5
3	Attendance	05
4	Library Usage	05
5	Skill Enhancement *	05
	Total	**25**

Breakup for Attendance Marks:

S.No	Attendance Range	Marks Awarded
1	95% and Above	5
2	90% - 94%	4
3	85% - 89%	3
4	80% - 84%	2
5	75% - 79%	1

Note:

Special Cases such as NCC, NSS, Sports, Advanced Learner Course, Summer Fellowship and Medical Conditions etc. the attendance exemption may be given by principal and Mark may be awarded.

Break up for Library Marks:

S.No	Attendance Range	Marks Awarded
1	10h and above	5
2	9h- less than 10h	4
3	8h - less than 9h	3
4	7h - less than 8h	2
5	6h - less than 7h	1

Note:
In exception, the utilization of e-resources of library will be considered.

***Components for "Skill Enhancement" may include the following:**

Class Participation, Case Studies Presentation/Term paper, Field Study, Field Survey, Group Discussion, Term Paper, Presentation of Papers in Conferences, Industry Visit, Book Review, Journal Review, e-content Creation, Model Preparation, Seminar and Assignment.

Components for Skill Enhancement
Any one of the following should be selected by the course coordinator

S.No.	Skill Enhancement	Description
1	Class Participation	• Engagement in class • Listening Skills • Behaviour
2	Case Study Presentation/ Term Paper	• Identification of the problem • Case Analysis • Effective Solution using creativity/imagination
3	Field Study	• Selection of Topic • Demonstration of Topic • Analysis & Conclusion
4	Field Survey	• Chosen Problem • Design and quality of survey • Analysis of survey

5	Group Discussion	• Communication skills • Subject knowledge • Attitude and way of presentation • Confidence • Listening Skill
6	Presentation of Papers in Conferences	• Sponsored • International/National • Presentation • Report Submission
7	Industry Visit	• Chosen Domain • Quality of the work • Analysis of the Report • Presentation
8	Book Review	• Content • Interpretation and Inferences of the text • Supporting Details • Presentation
9	Journal Review	• Analytical Thinking • Interpretation and Inferences • Exploring the perception if chosen genre • Presentation
10	e-content Creation	• Logo/ Tagline • Purpose • Content (Writing, designing and posting in Social Media) • Presentation
11	Model Preparation	• Theme/ Topic • Depth of background Knowledge • Creativity • Presentation
12	Seminar	• Knowledge and Content • Organization • Understanding • Presentation

13	Assignment	• Content and Style • Spelling and Grammar • References

ii) Distribution of External Marks

Total	:	75
Written Exam	:	75

Marks Distribution for Practical course

Total	:	100
Internal	:	40
External	:	60

i) **Distribution of Internals Marks**

S. No.	Particulars	Distribution of Marks
1	Experiments/Exercises	15
2	Test 1	10
3	Test 2	10
4	Observation Notebook	05
	Total	**40**

ii) Distribution of Externals Marks

S.No.	Particulars	External Marks
1	Practical	40
2	Record	10
3	Viva- voce	10
	Total	**60**

Practical examination shall be evaluated jointly by Internal and External Examiners.

A) Mark Distribution for Project

Total	:	200
Internal	:	80
External	:	120

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	30
2	Review II	40
3	Attendance	10
	Total	**80**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Project Work & Presentation	100
2	Viva -voce	20
	Total	**120**

Evaluation of Project Work shall be done jointly by Internal and External Examiners.

6 . Credit Transfer

a. Upon successful completion of 1 NPTEL Course (4 Credit Course) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of one **4 credit course** during the 3rd semester. The proposed NPTEL course should cover content/syllabus of exempted core paper in 3rd semester.

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	4
			Option – 2 Paper title	
			Option – 3 Paper title	

b. Upon successful completion of **2 NPTEL Courses** (2 Credit each) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of **one 4 credit course** during the 3rd semester. Out of 2 NPTEL proposed courses, **at least 1 course** should cover content/syllabus of exempted core paper in 3rd semester.

<u>Mandatory</u>

The exempted core paper in the 3rd semester should be submitted by the students for approval before the end of 2nd semester

Credit transfer will be decided by equivalence committee

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	
2			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	

NPTEL Courses to be carried out during semester I – II.

S. No.	Student Name	Class	Proposed NPTEL Course		Proposed Course for Exemption
			Course I	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	Any one Core Paper in 3rd Semester
			Course II	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	

Class Advisor **HoD** **Dean**

7. Internship/Industrial Training

Mark Distribution for Internship/ Industrial Training

Total	**:**	**100**
Internal	**:**	**40**
External	**:**	**60**

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	15
2	Review II	20
3	Attendance	5
	Total	**40**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Internship /Industrial training Presentation	40
2	Viva –voce	20
	Total	**60**

Internship/ Industrial training shall be evaluated jointly by Internal and External Examiners.

9. Extra Credits: 10

Earning extra credit is not essential for programme completion. Student is entitled to earn extra credit for achievement in Curricular/Co-Curricular/ Extracurricular activities carried out other than the regular class hours.

A student is permitted to earn a maximum of 10 extra Credits during the programme period. A maximum of 1 credit under each category is permissible.

Category	Credit
Self study Course	1
CA/ICSI/CMA (Foundations)	1
CA/ICSI/CMA (Inter)	1
Sports and Games	1
Publications / Conference Presentations (Oral/Poster)/Awards	1
Innovation / Incubation / Patent / Sponsored Projects / Consultancy	1
Representation in State / National level celebrations	1
Awards/Recognitions/Fellowships	1
Advanced Learner Course (ALC)*	2

Credit shall be awarded for achievements of the student during the period of study only.

GUIDELINES

Self study Course

A pass in the self study courses offered by the department.

The candidate should register the self study course offered by the department only in the III semester.

CA/ICSI/CMA(Foundations)

Qualifying foundation in CA/ICSI/CMA / etc.

CA/ICSI/CMA(Inter)

Qualifying Inter in CA/ICSI/CMA / etc.

Sports and Games

The Student can earn extra credit based on their Achievement in sports in University/ State / National/ International.

Publications / Conference Presentations (Oral/Poster)

Research Publications in Journals

Oral/Poster presentation in Conference

Innovation / Incubation / Patent / Sponsored Projects / Consultancy

Development of model/ Products /Prototype /Process/App/Registration of Patents/ Copyrights/Trademarks/Sponsored Projects /Consultancy

Representation in State/ National level celebrations

State / National level celebrations such as Independence day, Republic day Parade, National Integration camp etc.

Awards/Recognitions/Fellowships

Regional/ State / National level awards/ Recognitions/Fellowships

***Advanced Learner Course (ALC):**

ALC is doing work of a higher standard than usual for students at that stage in their education.

Research work/internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days will be considered as Advanced Learners Course.

QUESTION PAPER PATTERN

CIA Test I : [1½ Hours-2.5 Units] - 25 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	8 x 0.5= 04 Marks	MCQ	25 Marks	Marks secured will be converted To 5 mark
Section - B	3 x 2 = 06 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		
Section - C	3 x 05 = 15 Marks			

CIA Test II/ Model [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	10 x 1 = 10 Marks	MCQ	75 Marks	Marks secured will be converted To 5 mark
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks		
Section - C	5 x 8 = 40 Marks			
Section - D	1 x 10 = 10 Marks	Compulsory Question		

End Semester Examination [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL
Section – A	10 x 1 = 10 Marks	MCQ	
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	75 Marks
Section - C	5 x 8 = 40 Marks		
Section - D	1 x 10 = 10 Marks	Compulsory Question	

Course Code	Course Name	Category	L	T	P	Credit
232MT2A1CA	ALGEBRA	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- elementary group theory and how to solve contemporary problems
- elementary principles on certain algebraic structures
- Sylow's theorems that describe the structure of certain finite groups

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	define the orbits and p-groups	K1
CO2	apply Sylow theory in the factorization of polynomials	K2
CO3	analyze the structure of finite fields	K3
CO4	explain the applications of Automorphisms and Isomorphism	K5
CO5	explain the applications of Galois theory	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2				✓	✓
CO3		✓		✓	
CO4		✓	✓		
CO5	✓	✓	✓		✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1CA	ALGEBRA	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Direct Products 12 h

External and internal direct products - group action on a set: Fixed sets and Isotropy subgroups – orbits - application on G-Sets to counting: p-groups - Sylow theorems.

Unit II Applications of the Sylow Theory and Rings of Polynomials 11 h

Applications to p-Groups and the class equation - further applications. Rings of polynomials: polynomials in an indeterminate - evaluation homomorphisms - division algorithm in $F[x]$ - irreducible polynomials – ideal structure in $F[x]$ - uniqueness of factorization in $F[x]$.

Unit III Introduction to Extension Fields 13 h

Extension fields - algebraic and transcendental elements - irreducible polynomial for α over F - simple extensions -Algebraic extensions: finite extensions – algebraically closed fields and algebraic closures.

Unit IV Automorphisms of Fields 14 h

Basic isomorphism of algebraic field theory - Automorphisms and fixed fields - Frobenius automorphism - Isomorphism extension theorem: extension theorem - splitting fields.

Unit V Separable Extensions and Galois Theory 10 h

Multiplicity of zeros of a polynomial-separable extensions-perfect fields-normal extensions - main theorem - Galois group over finite fields - illustrations of Galois theory: symmetric functions

Text Books

1 Fraleigh J.B, 2003,"A First Course in Abstract Algebra", 3rd Edition, Narosa Publishing House, New Delhi.

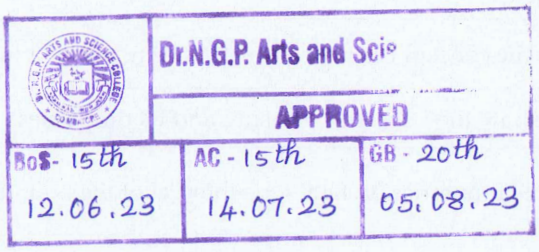
References

1 Herstein I.N, 2007, "Topics in Algebra", 2nd Edition, Narosa Publishing House, New Delhi.

2 Artin M, 1991, "Algebra", Prentice-Hall of India, New Delhi.

3 Fraleigh J.B, 2014,"A First Course in Abstract Algebra", Seventh Edition, Pearson Education Limited, London.

4 Anderson M and Feil T, 2014, "A First Course in Abstract Algebra Rings, Groups, and Fields", 3rd Edition, Chapman and Hall/CRC, London.



Course Code	Course Name	Category	L	T	P	Credit
232MT2A1CB	ADVANCED ANALYSIS	CORE	4	2	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the concept of Riemann Stieltjes integral
- the inverse and Implicit function theorems
- the concept of Lebesgue measure and Lebesgue integral

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	identify the Riemann Stieltjes Integral of various real functions	K1
CO2	describe the properties of various forms of uniform convergence and continuity	K2
CO3	discuss the concept behind contraction principle of a function	K3
CO4	demonstrate the Lebesgue measure and its properties	K4
CO5	apply the properties of Lebesgue integral of the bounded functions	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓		✓	
CO5	✓	✓		✓	

MAPPING WITH PROGRAMME OUTCOMES

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1CB	ADVANCED ANALYSIS	SEMESTER I

Total Credits: 4
Total Instructions Hours: 72 h

Syllabus

Unit I Riemann Stieltjes Integral 15h

Definition and existence of the Integral – properties of the integral – Integration and differentiation – Integration of vector valued functions – rectifiable curves.

Unit II Sequences and Series of Functions 14 h

Uniform convergence and continuity – uniform convergence and integration - uniform convergence and differentiation – equicontinuous families of functions – The Stone Weierstrass theorem.

Unit III Functions of Several Variables 14 h

Linear transformations-differentiation – contraction principle – Inverse function theorem – Implicit function theorem.

Unit IV Lebesgue Measure 14 h

Outer measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's three principles.

Unit V Lebesgue Integral 15h

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

Text Book

1 Walter Rudin, 1976, Principles of Mathematical Analysis, McGraw Hill, New York.

2 H.L. Roydon, 2005, Real Analysis, Third Edition, Prentice Hall of India, New Delhi.

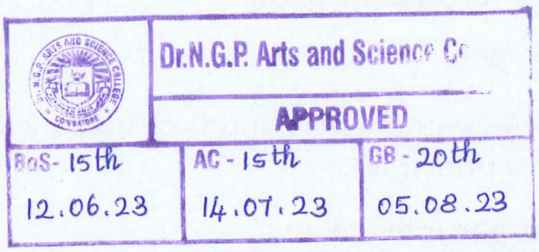
References

1 R. G. Bartle, 1976, Elements of Real Analysis, 2nd Edition, John Wily and Sons, New York,.

2 Mainak Mukherjee, 2015, A course in Real Analysis, Narosa publishing house. New Delhi.

3 Tom M Apostol, 2002, Mathematical Analysis, Narosa Publishing House Pvt Ltd., Second Edition, New Delhi.

4 Somasundaram.D and Choudhary,B. 2015, A first course in Mathematical Analysis, Narosa publishing house, New Delhi.



Course Code	Course Name	Category	L	T	P	Credit
232MT2A1CC	ORDINARY DIFFERENTIAL EQUATIONS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the first order and second order ordinary differential equations
- the usage of power series method to solve differential equations
- the homogenous and non-homogenous ordinary differential equations

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	define Legendre and Bessel equations	K2
CO2	discribe the concept of fundamental matrix of systems	K2
CO3	apply Lipschitz condition in Mathematical problems	K3
CO4	inspect the existence and uniqueness of solutions	K4
CO5	analyze the solution using oscillatory theorems	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2		✓	✓		✓
CO3	✓	✓		✓	✓
CO4	✓		✓		
CO5	✓	✓	✓		✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1CC	ORDINARY DIFFERENTIAL EQUATIONS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Solutions in power series 12 h

Introduction-second order linear equations with ordinary points-Legendre equation and Legendre polynomials-second order equation with regular singular point-properties of Bessel functions.

Unit II System of Linear differential equations 11 h

System of first order equations- model for ARMS competition between two nations-existence and uniqueness theorem-fundamental matrix.

Unit III Non homogeneous linear system 10 h

Non-homogeneous linear systems- linear system with constant coefficients- linear systems with periodic coefficients.

Unit IV Existence and uniqueness of solutions 13 h

Preliminaries- successive approximations- Picard's theorem- some examples-continuation and dependence on initial conditions- existence of solutions in the large- existence and uniqueness of solutions of system.

Unit V Oscillations of second order equations 14 h

Fundamental results- Sturm's comparison theorem- elementary linear oscillations-comparison theorem of Hille-Winter -Oscillations of $x'' + a(t)x = 0$

Text Books

1 Deo S.G, Lakshmikandham V and Raghavendra V, 2007, "Text book of Ordinary Differential Equations", Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

References

1 Reid W T, 1971, "Ordinary Differential Equations", John Wiley & sons, New York.

2 Coddington E A and Levinson N, 2006, "Theory of Ordinary Differential Equations", Tata McGraw-Hill Publishing Company Limited, New Delhi.

3 Tesch I G, 2012, "Ordinary Differential Equations and Dynamics Systems", American Mathematical Society, Providence.

4 Coddington E A, 2006, "An introduction to Ordinary Differential Equations", PHI Private Limited, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
232MT2A1CD	OPERATIONS RESEARCH	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the dynamic, integer programming and decision analysis
- concept of queueing and inventory
- the method of solving the queueing models

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	illustrate the characteristics of dynamic programming problem	K2
CO2	derive importance of integer programming	K5
CO3	explain the concept of Markov chain and Markov process in decision making	K3
CO4	define the behavior of various queueing models	K4
CO5	analyze the applications of inventory	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓		
CO2		✓			✓
CO3	✓			✓	
CO4			✓		✓
CO5	✓	✓			

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1CD	OPERATIONS RESEARCH	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Dynamic Programming 14 h

Prototype example for dynamic programming - characteristics of dynamic programming problems - deterministic and probabilistic dynamic programming

Unit II Integer Programming 13 h

Prototype example - some BIP applications - innovative uses of binary variables in model formulation - some formulation examples - some perspectives on solving integer programming problems

Unit III Decision Analysis 10 h

Prototype example - decision making without experimentation - decision making with experimentation - decision trees, Markov chains: Stochastic processes - Markov chains

Unit IV Queueing Theory 12 h

Prototype example - basic structure - examples of real Queueing systems - role of the exponential distribution – birth and death process - Queueing models based on birth and death process

Unit V Inventory Theory 11 h

Examples - components - deterministic continuous and periodic review model - deterministic multiechelon inventory model for supply chain management

Text Books

1 Frederick S. Hillier, Gerald J. Lieberman, 2010,"Introduction to Operations Research-Concepts and Cases ", 9th Edition, McGraw-Hill Companies, New Delhi.

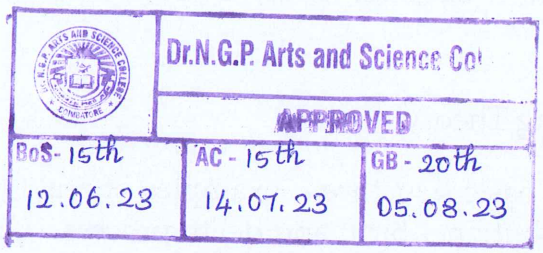
References

1 Taha H.A, 2006, "Operations Research: An Introduction", 8th Edition, Prentice-Hall of India Private Limited, New Delhi.

2 Kandiswarup, Gupta P.K and Man Mohan, 1998,"Operations Research", S. Chand & Sons Education Publications, New Delhi.

3 Ravindran, Phillips D.T and Solberg J.J, 2005, "Operations Research-Principles and Practice", & John Wiley Sons, New Jersey.

4 Hillier F and Lieberman G, 2010, "Introduction to Operations Research", 9th Edition, McGraw-Hill Professional, New Delh.



Course Code	Course Name	Category	L	T	P	Credit
232MT2A1CE	ADVANCED STATISTICS	CORE	3	2	-	3

PREAMBLE

This course has been designed for students to learn and understand

- the procedure of finding estimation
- the methods of testing hypothesis under various conditions
- the importance of linear regression models

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	define the point estimation	K1
CO2	identity the confidence intervals for population variance and population parameters	K2
CO3	explain the procedures for hypothesis testing	K3
CO4	analyze the linear regression models and method of solving it variance	K4
CO5	apply various types of non-parametric test to validate hypothesis	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓		✓	
CO2	✓			✓	
CO3	✓	✓			✓
CO4			✓	✓	
CO5	✓	✓			✓

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1CE	ADVANCED STATISTICS	SEMESTER I

Total Credits: 3

Total Instruction Hours: 60 h

Syllabus

Unit I Point Estimation 12 h

Introduction-method of moments and maximum likelihood-some desirable properties of point estimators-other desirable properties.

Unit II Interval Estimation 12 h

Introduction–large sample confidence intervals: one sample case-small sample confidence intervals for μ-a confidence interval for the population variance-confidence interval concerning two population parameters.

Unit III Hypothesis Testing 12 h

Introduction-Neyman-Pearson-likelihood ratio test–hypotheses for a single parameter-testing of Hypotheses for two samples-Chi-Square tests for count data.

Unit IV Linear Regression Models 12 h

Introduction–simple linear regression model-inferences on the least square estimators-predicting a particular value.

Unit V Non Parametric Tests 12 h

Introduction –nonparametric confidence interval-nonparametric hypothesis tests for one sample-nonparametric hypothesis tests for two independent samples nonparametric hypothesis tests for $k \geq 2$ sample.

Text Books

1 Kandethody M. Ramachandran, Chris P. Tsokos, 2009, "Mathematical Statistics with Applications", Elsevier, Gurgaon.

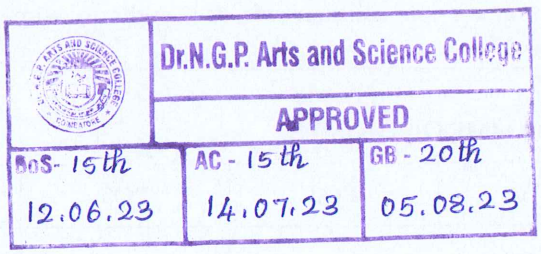
References

1 Irwin Miller and Marylees Miller, John E. Freund's, 2007,"Mathematical Statistics with Applications", Seventh Edition, Prentices-Hall India Pvt Ltd, New Delhi.

2 Hogg and Craig, 2003, "Introduction to Mathematical Statistics", Pearson Education, New Delhi.

3 J.M. Kapur and H.C. Saxena, 2001, "Mathematical Statistics", S. Chand & Co, New Delhi.

4 Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye,2018,Probability and Statistics, Pearson Education, New Delhi.



Course Code	Course Name	Category	L	T	P	Credit
232MT2A1DA	NUMERICAL ANALYSIS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the method of solving nonlinear equations
- analyze the solution of ordinary differential equations
- analyze the convergence of various methods

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	identify the numerical method to solve nonlinear equations	K1
CO2	categorize the system of equations and solve by appropriate method	K2
CO3	examine the solution got by applying various of numerical differentiation and integration methods	K3
CO4	Analyze the method of solving differential equation and the way to find optimized solution	K4
CO5	analyze the nature of solution of one and two dimensional partial differential equations	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1					
CO2	✓				
CO3	✓				
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1DA	NUMERICAL ANALYSIS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Nonlinear Equations 10 h

Interval halving (Bisection) - linear interpolation methods - Newton's method - Muller's method - fixed-point iteration: $x = g(x)$ method - Multiple Roots - Nonlinear Systems

Unit II Solving System of Equations 10 h

Matrices and Vectors - elimination methods - inverse of a matrix and matrix pathology - Ill-Conditioned systems - iterative methods - parallel processing

Unit III Numerical Differentiation and Integration 10 h

Derivatives from divided difference table - higher order derivatives - extrapolation techniques -Trapezoidal rule - Simpson's rules - Fourier Series and Fourier Transforms - adaptive integration - Gaussian quadrature - multiple Integrals - applications of Cubic Splines

Unit IV Numerical Solution of Ordinary Differential Equations and Optimization 9 h

Taylor-Series Method - Euler method - Runge- Kutta methods - multistep methods - Higher-Order Equations and Systems. Optimization: finding the minimum of $y = f(x)$- minimizing a function of several variables-linear programming

Unit V Numerical Solutions of Partial-Differential Equations 9 h

Elliptic equations: Liebmann's method - Poisson's equation - derivative boundary conditions - implicit method - Parabolic equations: heat equation - Crank-Nicolson method - Theta method - stability - analytical argument- Hyperbolic equations: vibrating string - D'Alembert solution - wave equation.

Text Books

1 Gerald C. F. and Wheatley P. O., 1999, "Applied Numerical Analysis", 7th Edition, Pearson Education, New York.

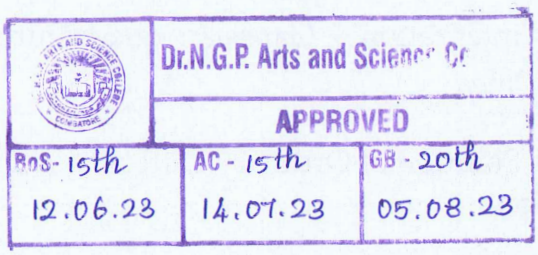
References

1 Smith. G. D., 1985, "Numerical Solution of Partial Differential Equations – Finite Difference Methods", Oxford University Press, Oxford.

2 Jain M. K., Iyengar S. R. K. and Jain R. K., 1993, "Numerical Methods for Scientific and Engineering Computation", 3rd Edition, Wiley Eastern Ltd, Noida.

3 Marghitu D. B. and Dupac M., 2012, "Advanced Dynamics: Analytical and Numerical Calculations with MATLAB", Springer, New York.

4 Samuel Conte D. and Boor C. D., 1983, "Elementary Numerical Analysis", McGraw- Hill International Edition, New Delhi.



Course Code	Course Name	Category	L	T	P	Credit
232MT2A1DB	COMMUTATIVE ALGEBRA	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the concepts of ideals and modules through examples
- the properties to decompose the Noetherian and Artin rings.
- the importance of dimension theory of rings and modules.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	define new modules using operations like tensor product and other operations	K1
CO2	discuss the construction of field	K2
CO3	demonstrate the concept of integral dependence of extension ring and chain conditions of modules.	K3
CO4	analyze the importance of discrete valuation of rings and dedekind domains	K4
CO5	summarize the various forms of dimension theory and its influence in local rings	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	✓
CO3	✓	✓		✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓		✓	✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1DB	COMMUTATIVE ALGEBRA	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Rings and Ideals 9 h

Rings and ring homomorphisms - ideals - quotient rings - zero divisors, nilpotent elements, units - prime ideal and maximal ideals - nilradical and Jacobson radical - operations on ideals - extension and contraction.

Modules: modules and module homomorphisms - submodulus and quotient modulus - operations on submodules - finitely generated modulus

Unit II Rings ,modules of fractions and primary decomposition 9 h

Local properties - extended and contracted ideals in rings of fractions - primary decomposition

Unit III Integral dependence and valuations 9 h

Integral dependence - the going up theorem -Integrally closed integral domains - the going down theorem - valuation rings - Chain conditions

Unit IV Noetherian rings, artin rings , Discrete valuation rings and Dedekind domains 9 h

Primary decomposition in Noetherian rings - Artin rings -structure theorem for Artin rings- Discrete valuation rings - Dedekind domains - Fractional ideals

Unit V Completions and Dimension Theory 12 h

Topologies and completions - filtrations - graded rings and modules - the associated graded ring - Hilbert functions - dimension theory of Noetherian local rings - regular local rings - Transcendental dimension

Text Books

1 Atiyah-Macdonald, 1994, Commutative Algebra, Westview Press, London

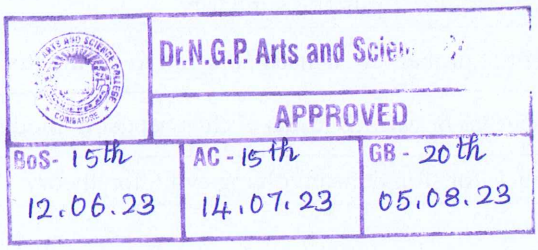
References

1 Zariski and Samuel, 1991, Commutative Algebra I, II, Springer, New York.

2 Eisenbud, 1995 Commutative Algebra with a View Towards Algebraic Geometry, Springer, New York.

3 Bourbaki, 1989, Commutative Algebra, Springer, New York.

4 Herstein I N, 2000, Topics in Algebra, Second Edition, John Wiley and Sons, New Jersey.



Course Code	Course Name	Category	L	T	P	Credit
232MT2A1DC	MATHEMATICAL MODELING	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the deterministic states and analysis of models
- the stochastic analysis of models
- various evolution of models

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	describe the optimal power and exponential models	K2
CO2	discuss the dimensional analysis and similarity	K2
CO3	apply the concept of probability density function to define stochastic states	K3
CO4	analyze the properties of various forms of changes using modeling	K4
CO5	develop the models for situations involving evolution theory	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		
CO2	✓		✓		
CO3		✓		✓	✓
CO4			✓	✓	
CO5		✓		✓	✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A1DC	MATHEMATICAL MODELING	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Deterministic Analysis of Observations 9 h

Data transformations: Linear model –polynomial models –population modeling – global warming modeling - model errors – optimal linear models – optimal quadratic models – optimal power and exponential models.

Unit II Deterministic States 10 h

Dimensional analysis and similarity - applications of low-complexity – applications of medium complexity- time measurement - applications of high-complexity.

Unit III Stochastic States 9 h

Probability density functions – models for probability density functions – data analysis – real distribution.

Unit IV Deterministic and stochastic Changes 10 h

Linear changes - linear changes with delays - nonlinear changes - linear stochastic changes - diffusion - Brownian motion - population dynamics.

Unit V Deterministic and Stochastic Evolution 10 h

Heat and Mass Transfer: Balance – Newton's laws of motion: oscillations – population ecology: growth and self-limitation – oscillations and collapse - PDF evolution equations - Solutions to the Fokker Plank equation.

Text Books

1 Stefen Heinz, 2011,"Mathematical Modeling", Springer-Verlag, New York

References

1 J.N. Kapur, 1998, "Mathematical Modeling", New Age International (P) Limited, New Delhi

2 Crossand, and Moscrcadini A.O, 1976,"The Art of Mathematical Modeling", Ellis Harwood and John Wiley, New york

3 Sarah. P.Otto and Troy Day, 2000, "A Biologist guide to Mathematical Modeling in Ecology and Evolution", Princeton University Press, Princeton

4 Frank. R.Glordance, Maurice D. Weir and William P.Fox, 2003, "A First course in Mathematical Modeling", Thomson Learning, London

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