B.Sc.Mathematics (Honours)
Choice Based Credit System (CBCS)

(2021- 22 onwards)

Curriculum and Syllabi

Department of Mathematics

School of Advanced Sciences

Kalasalingam Academy of Research and Education

Krishnankoil, Srivilliputhur – 626 126.

CURRICULUM AND SYLLABUS

B.Sc. (HONOURS) IN MATHEMATICS

Choice Based Credit System (2021-22 onwards)

DEPARTMENT OF MATHEMATICS
SCHOOL OF ADVANCED SCIENCES

2021

KALASALINGAM
ACADEMY OF RESEARCH & EDUCATION
(DEEMED TO BE UNIVERSITY)
Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade
Anand Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

UNIVERSITY VISION

To be a Center of Excellence of International Repute in Education and Research.

UNIVERSITY MISSION

To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research.

VISION OF THE DEPARTMENT

To be a global centre of excellence in mathematics for the growth of science and technology.

MISSION OF THE DEPARTMENT

- To provide quality education and research in mathematics through updated curriculum and effective teaching learningprocess.
- To inculcate innovative skills, team work and ethical practices among students so as to meet societalexpectations.

PROGRAMME OUTCOMES (PO)

POs describe what students are expected to know or to be able to do by the time of graduation from the programme. The Program Outcomes of UG in Mathematics are:

PROGRAMME OUTCOMES (POs)

PO1 **Scientific knowledge:** Gain and apply the fundamentals of mathematics, natural sciences, and applied sciences for the usage of modern scientific instrumentation, laboratory techniques and solving the challenges in modern scientific society

PO2 **Problem analysis:** Identify, formulate, and analyze the complex scientific problems reaching substantiated conclusions.

PO3 **Design/development of solutions:** Develop the solutions for complex problems using research-based knowledge including design of experiments, analysis and interpretation of data that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal, and environmental considerations.

PO4 **Modern tools usage:** Create, select, and apply appropriate techniques, resources, and modern computing/electronic tools.

PO5 **Social responsibility:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.

PO6 **Environment and sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge for the sustainable development.

PO7 **Ethics and Values:** Apply and commit towards professional ethical principles, ethical responsibilities, and norms of the scientific practice.

PO8 **Individual and team work:** Function effectively in multidisciplinary settings as an individual or leader in group.

PO9 **Communication:** Communicate effectively on complex activities with the scientific community and with the society at large, being able to comprehend and write effective reports, design documentation and make effective presentations.

PO10 **National and International Perspectives:** Contribution towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.

PO11 **Project management:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning towards the broadest context of scientific and societal change

B.Sc. MATHEMATICS (HONOURS) - PROPOSED CURRICULUM STRUCTURE

CBCS (2021-22 onwards)

BROAD STRUCTURE

Course Types	No. of Courses	Total Credits
Foundation Core Courses	08	30
Program Core Courses (7×6=42; 7×4=28)	14	70
Generic Electives (4×4=16)	04	16
Discipline Specific Electives (2×4=8; 2×3=6)	04	14
Skill Enhancement Courses (2×3=6; 2×2=4)	04	10
Total	**34**	**140**

LIST OF FOUNDATION CORE COURSES

Course Code	Course Title	L	T	P	X	Hr	C
211ENG1302	English – I	4	0	0	3	7	5
211ENG1305	Professional Skills	1	0	0	3	4	2
211ENG1303/ 211TAM1301/ 211HIN1301	English – II/Tamil/Hindi	3	0	0	3	6	4
211BCA1301	Digital Skills	3	0	2	3	8	5
211ENG1306	Communicative English	3	0	2	3	8	5
211MAT1304	Basic Statistics	2	0	0	3	5	3
211CHY1101	Environmental Science	3	0	0	0	3	3
211ENG1304	Human Values	2	0	0	3	5	3
Total		**21**	**0**	**4**	**21**	**46**	**30**

LIST OF PROGRAM CORE COURSES

Course Code	Course Title	L	T	P	X	Hr	C
212MAT2101	Set Theory	6	0	0	0	6	6
212MAT2102	Differential and Integral Calculus	4	0	0	0	4	4
212MAT2103	Linear Programming	5	1	0	0	6	6
212MAT2104	Differential Equations	3	1	0	0	4	4
212MAT2105	Elementary Algebra	5	1	0	0	6	6
212MAT2106	Modern Algebra	5	1	0	0	6	6
212MAT2107	Discrete Mathematics	5	1	0	0	6	6
212MAT2108	Real Analysis	5	1	0	0	6	6
212MAT1109	Linear Algebra	3	1	0	0	4	4
212MAT1110	Differential Geometry	3	1	0	0	4	4
212MAT2111	Complex Analysis	5	1	0	0	6	6
212MAT1112	Number Theory	3	1	0	0	4	4
212MAT1113	Probability and Distribution Theory	3	1	0	0	4	4
212MAT1114	Graph Theory	3	1	0	0	4	4
	Total	**56**	**14**	**0**	**0**	**70**	**70**

LIST OF GENERIC ELECTIVE COURSES

Course Code	Course Title	L	T	P	X	Hr	C
213PHY1301	Physics - I (IC)	3	0	2	0	5	4
213PHY1302	Physics - II (IC)	3	0	2	0	5	4
213BCA1301	C++ Programming for Mathematics	3	0	2	0	5	4
213MAT1301	Fourier Series and Applications	3	0	2	0	5	4
	Total	**12**	**0**	**8**	**0**	**20**	**16**

LIST OF DISCIPLINE SPECIFIC ELECTIVE COURSES

Course Code	Course Title	L	T	P	X	Hr	C
213MAT2101	Mathematical Modelling	4	0	0	0	4	4
213MAT2102	Mathematical Biology	4	0	0	0	4	4
213MAT2103	Actuarial Mathematics	4	0	0	0	4	4
213MAT2104	Cryptography	4	0	0	0	4	4
213MAT2105	Financial Mathematics	3	0	0	0	3	3
213MAT2106	Algorithmic Graph Theory	3	0	0	0	3	3
213MAT2107	Astronomy	3	0	0	0	3	3
	Total (four courses)						25

LIST OF SKILL ENHANCEMENT COURSES

Course Code	Course Title	L	T	P	X	Hr	C
214MAT1101	Integral Transforms (X-option)	2	0	0	3	5	3
214MAT1102	Vector Calculus (X-option)	2	0	0	3	5	3
214MAT1103	Introduction to Special Functions (X – option)	1	0	0	3	4	2
214MAT1104	Basic LATEX (X-option)	1	0	0	3	4	2
	Total	6	0	0	12	18	10

SEMESTERWISE DISTRIBUTION

Sem.	Category	Course Code	Course Title	L	T	P	X	Hr	C
I	FC	211ENG1302	English I	4	0	0	3	7	5
	FC	211ENG1305	Professional Skills	1	0	0	3	4	2
	$CORE_{6c}$	212MAT2101	Set Theory	5	1	0	0	6	6
	$CORE_{4c}$	212MAT2102	Differential and Integral Calculus	3	1	0	0	4	4
	GE	214PHY1301	Physics – I	3	0	2	0	5	4
			Total	**16**	**2**	**2**	**6**	**26**	**21**
II	FC	311ENG1303/ 211TAM1301/ 211HIN1301	English – II/Tamil/Hindi	3	0	0	3	6	4
	FC	211MAT1304	Basic Statistics	2	0	0	3	5	3
	$CORE_{6c}$	212MAT2103	Linear Programming	5	1	0	0	6	6
	$CORE_{4c}$	212MAT2104	Differential Equations	3	1	0	0	4	4
	GE	214PHY1302	Physics – II	3	0	2	0	5	4
			Total	**16**	**2**	**2**	**6**	**26**	**21**
III	FC	211ENG1306	Communicative English	3	0	2	3	8	5
	FC	211CHY1101	Environmental Science	3	0	0	0	3	3
	$CORE_{6c}$	212MAT2105	Elementary Algebra	5	1	0	0	6	6
	DSE_{3c}	213MAT2101	Mathematical Modeling	3	0	0	0	3	3
	GE	214CAS1301	C++ Programming for Mathematics	3	0	2	0	5	4
	SEC	212MAT1301	Integral Transforms	2	0	0	3	5	3
			Total	**19**	**1**	**4**	**6**	**30**	**24**
IV	FC	211BCA1301	Digital Skills	3	0	2	3	8	5
	FC	211ENG1304	Human Values	2	0	0	3	5	3
	$CORE_{6c}$	212MAT2106	Modern Algebra	5	1	0	0	6	6
	DSE_{4c}	213MAT2102	Mathematical Biology	4	0	0	0	4	4
	GE	214MAT1301	Fourier Series and Applications	3	0	2	0	5	4
	SEC	212MAT1302	Vector Calculus	2	0	0	3	5	3
			Total	**19**	**1**	**4**	**9**	**33**	**25**
V	$CORE_{6c}$	212MAT2107	Discrete Mathematics	5	1	0	0	6	6
	$CORE_{6c}$	212MAT2108	Real Analysis	5	1	0	0	6	6
	$CORE_{4c}$	212MAT1109	Linear Algebra	3	1	0	0	4	4
	$CORE_{4c}$	212MAT1110	Differential Geometry	3	1	0	0	4	4
	DSE_{3c}	213MAT2107	Astronomy	3	0	0	0	3	3
	SEC	212MAT1303	Introduction to Special Functions	1	0	0	3	4	2
			Total	**20**	**4**	**0**	**3**	**27**	**25**
VI	$CORE_{6c}$	212MAT2111	Complex Analysis	5	1	0	0	6	6
	$CORE_{4c}$	212MAT1112	Number Theory	3	1	0	0	4	4
	$CORE_{4c}$	212MAT1113	Probability and Distribution Theory	3	1	0	0	4	4

	CORE 4c	212MAT1114	Graph Theory	3	1	0	0	4	4
	DSE4c	213MAT2103	Actuarial Mathematics	4	0	0	0	4	4
	SEC	212MAT1304	Basic LATEX	1	0	0	3	4	2
			Total	**19**	**4**	**0**	**3**	**26**	**24**

CONSOLIDATED HOURS & CREDITS

Semester	L	T	P	X	Hr	C
I	**16**	**2**	**0**	**9**	**27**	**21**
II	**16**	**2**	**0**	**9**	**27**	**21**
III	**19**	**1**	**2**	**9**	**31**	**24**
IV	**19**	**1**	**2**	**12**	**34**	**25**
V	**20**	**4**	**0**	**3**	**27**	**25**
VI	**19**	**4**	**0**	**3**	**26**	**24**
Total Credits	**109**	**14**	**4**	**45**	**172**	**140**

FOUNDATION CORE COURSES

211ENG1305	PROFESSIONAL SKILLS	L	T	P	X	H	C
		1	0	0	3	4	2

Pre-requisite: Nil **Course Category:** Foundation Core

Course Type: Theory Course

Objective:

Professional skills are required for an individual to be gainfully employed for a successful and satisfied life. Professional skills are part of life skills. An individual should be able to demonstrate professional skills involving the use of intuitive, logical and critical thinking, communication and interpersonal skills, not limited to cognitive/creative skills. These skills, behavior and quality of output enhance employability.

Course Outcomes:

CO1: To provide opportunity for realizing one's potential through practical experience.

CO2: To increase one's knowledge and awareness of emotional competency and emotional intelligence at place of study/work.

CO3: To develop interpersonal skills and adopt good leadership behavior for empowerment of self and others.

CO4: To set appropriate goals, manage stress and time effectively.

CO5: To manage competency- mix at all levels for achieving excellence with ethics.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	1	
CO2	3	2		1									3	1	1
CO3	3		1										3	2	
CO4	3		1	2									3		1
CO5	3	2	2	1	1								3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Career Skills

Goal Setting – Critical Thinking- Self-esteem – Social skills– Interpersonal Skills —Public Speaking

Unit II: Team skills

Communication- Active Listening - Preparing resume/CV – Interview –

Unit III: Presentation Skills

Creative Thinking – Social Cultural Etiquettes – Presentation Skills – Body Language

Unit IV: Leadership Skills

Problem Solving – Strategic Thinking Skills – Creativity

Unit V: Management Skills

Decision Making –Stress Management – Tips to relieve from stress – Yoga - Meditation

Text Books:

1. Kevin Retz. *The Professional Skills Handbook for Engineers and Technical Professionals*, CRC Press, Taylor and Francis Group, London, 2019.
2. Stephanie Lynn Slocum. *SHE Engineers.* Engineers Rising LLC; 1st edition, 2018. USA.

Reference Books:

1. Sangeetha Sharma and Binod Mishra. *Communication Skills for Engineers and Scientists*. PHI Learning, New Delhi. 2010.
2. Wolfgang Linden. *Stress Management: From Basic Science to Best Practice.* Sage Publications, New Delhi. 2005.

211ENG1303	ENGLISH II	L	T	P	X	H	C
		3	0	0	3	6	4

Pre-requisite: Nil **Course Category:** Foundation Core

Course Type: Theory Course

Objective:

The course aims to help the students achieve fluency and accuracy in English

Course Outcomes:

CO1: To introduce world-renowned poets to students.
CO2: To introduce world-renowned prose writers to students.
CO3: To make them understand the nuances of Indian plays.
CO4: To excel in Grammar.
CO5: To excel in Composition.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1										3	1	
CO2	3	2		1									3		1
CO3	3											1	3		
CO4	3		1	2									3		2
CO5	3	1	2	1	1							1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Poetry

Nissim Ezekiel- Enterprise
Kamala Das - The Dance of Eunuchs
Toru Dutt - Our Casuarina Tree
Sri Aurobindo- The Tiger and the Deer

Unit II: Prose

B. K. Bhattacharya – The Golden Goddess (Assamese)
Himanshu Vohra - A Member of the Family (Gujarati)
Lalithambika Antharjanam- Daughter of Man (Malayalam)
P. Lankesh – Bread (Kannada)

Unit III: Play

Girish Karnad - Hayavadana

Unit IV: Grammar

a) Parts of Speech
b) Articles
c) Sentence: Kinds, Types
d) Tense
f) Degrees of Comparison
g) Conditional Clause
h) Voice: Active & Passive
i) Concord

e) Reported Speech

Unit V: Composition

a) Expansion of Proverb
b) Letters, Email
c) Reading Comprehension
d) Cloze Test
e) Precis Writing
f) Note-Making
g) Writing Dialogues
h) Notices, Agenda, Minutes

211TAM1301	TAMIL-I இக்கால இலக்கியம்	L	T	P	X	H	C
		3	0	0	3	6	4
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

அலகு 1

மரபுக் கவிதை

சஞ்சீவி பர்வதத்தின் சாரல் – பாரதிதாசன்

அலகு 2

புதுக்கவிதை

1. பாரதியார் – முரசு
2. கவிமணி – பெண்கள் உரிமைகள்
3. கண்ணதாசன் – ஒன்று எங்கள் ஜாதியே
4. வைரமுத்து – தேசப் பாடகனுக்குத் தெருப்பாடகனின் அஞ்சலி
5. சிற்பி – அப்துல் கலாமின் வீணை
6. கல்யாண்ஜி - கண்டும் காணாமல்
7. தமிழச்சி தங்கபாண்டியன் – புன்னகையின் வன்முறை
8. அ. வெண்ணிலா – அம்மாக் குழந்தை
9. சல்மா – விலகிப் போகும் வாழ்க்கை
10. சுகிர்தராணி – அம்மா
11. சக்தி ஜோதி – மீன்களை வரைபவள்
12. ஷக்தி – சந்தேகமேயில்லை

அலகு 3

சிறுகதை

1. கு.அழகிரிசாமி – ராஜா வந்திருக்கிறார்
2. ச. தமிழ்ச் செல்வன் – வெயிலோடு போய்
3. அம்பை – வாகனம்
4. ஜெயமோகன் – சோற்றுக் கணக்கு
5. புதுமைப்பித்தன் – காலனும் கிழவியும்
6. இரா. தமிழ்நேசன் – ஆதி மூதாதையரின் ஜீன்கள்
7. புதியமாதவி – ஒரு பெரியாரிஸ்டின் தீபாவளி
8. சோ. தர்மன் - சோகவனம்

9. எஸ்.ராமகிருஷ்ணன் – தனிமையின் வீட்டிற்கு ஆயிரம் ஜன்னல்கள்
10. வண்ணதாசன் – ஒரு சிறு இசை

அலகு 4

நாவல்

கீதாரி – சு.தமிழ்ச்செல்வி

அலகு 5

நாடகம்

ஔவை – இன்குலாப்

பாடநூல்கள்

1. சஞ்சீவி பர்வதத்தின் சாரல் – பாரதிதாசன் (உரையாசிரியர் முனைவர் கமலா முருகன்), சாரதா பதிப்பகம், சென்னை, 2012.
2. கீதாரி – சு. தமிழ்ச்செல்வி, நியு செஞ்சுரி புக் ஹவுஸ், சென்னை, 2008
3. ஔவை – இன்குலாப், அன்னம் அகரம் பதிப்பகம், தஞ்சாவூர்.

211BCA1301	DIGITAL SKILLS	L	T	P	X	H	C
		3	0	2	3	8	5
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

Course Topics:

Unit I

Introduction to Computer - Basic Concepts - Basics of Operating System - Drive File Organization -File concepts and operations - File Directory - Working with command prompts- Internet- Concept of Internet - Applications of Internet - Connecting to the Internet, Troubleshooting-Internet Concept of Internet. Applications of Internet.Connecting to the Internet, Troubleshooting.

Unit II

Various applications of Internet - Dial up, ISDN and broadband- Introduction to Internet - addressing, Internet protocols - (TCP/IP, FTP and HTTP, IPV4, IPV6) - Instant messaging, - Use of Social Networking Sites. Word Processing Basics – I -Text Creation and manipulation, . Tables, pictures, Adjusting Page setting, Working with styles, Understand desktop publishing

Unit III

Google Apps – Drive - Docs and Sheet - Forms and Meet - Microsoft Excel – I - Understanding excel Interface - Typing and editing cell content - Calculating with formulas - Microsoft Excel – II - Formatting a worksheet -. Printing Worksheet - Creating Charts

Unit IV

Application of Digital Financial Services- Banking products - Payment Mode - Digital Signature- Basic Concepts of PowerPoint presentation -. Preparation of slides -. Digital

Emotional Intelligence -Digital Empathy - Self-Awareness and Management - Relationship Management.

Unit V

Cyber Security - Basic concepts of threats, security policies- Security mechanisms- Data Security and protection concept - .Identifying a secure web site Https, lock symbol. Security Considerations - Digital Safety - Behavioral Cyber- Risk Management. -.Content Cyber. Risk Management. - Commercial and Community Cyber.Risk Manag

211ENG1306	COMMUNICATIVE ENGLISH	L	T	P	X	H	C
		3	0	2	3	8	5
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

Objectives:

This course aims to impart better writing skills by sensitizing the learners to the dynamics of effective writing. To build up the learners confidence in oral and interpersonal communication by reinforcing the basics of pronunciation specially focusing on interviews / corporate meetings / international business travels.

Course Outcomes:

CO1: To improve and mould students interactive skills in different environments
CO2: To develop and improve students listening capacity
CO3: To enrich and understand students in speaking ability in different situations
CO4: To enhance students reading in through the text
CO5: To gain knowledge about written statements

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3		1										3	1	
CO2	3			2									3	1	1
CO3	3	1										1	3		
CO4	3	1	1										3		1
CO5	3	2	2									1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit – I Language in Professional context

Conversation - types of Conversation - steps involved in conversation - role of body language in conversation- face-to-face conversation - telephone conversation - telephone etiquette- telephone phrases- situational conversation - advantages and disadvantages - etiquettes of conversation.

Unit – II – Listening

Listening - types - techniques of effective listening – importance of active listening- barriers of listening - steps to effective listening - listening to the audio (including lyrics, telephone calls)- listening to the seminar (understanding the questions asked in seminar)- questioning skills & techniques- types of questions- question structure.

Unit – III – Speaking

Speaking - types - importance of speaking skill - fluency - self-introduction - on the spot topic - story telling - narrate any incident –story telling- Power Point Presentation- group discussion - debate.

Unit – IV – Reading

Reading - types - strategies of effective reading - skimming - scanning - reading the text - interpret the text - reading comprehension - cloze reading.

Unit – V – Writing

Writing - types - process of writing skill – general writing & professional writing- essay writing & paragraph writing- structure of an essay- blog writing- structure of blog writing- letter writing – formal & informal writing-giving instructions.

Text Books

1. Cambridge English: BEC Preliminary with answers. Cambridge University Press, New Delhi 2016.
2. Aruna Koneru, Professional Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

Reference Books

1. Dr. A. Vimala, *Career Preparation and Talent Management*, Oviya Publication, Coimbatore
2. V. Shasikumar and P V Dhanija, *Spoken English*. Pub. By: Tata Mcgraw Hill, New Delhi
3. Mohan ,Krishna &MeeraBannerji . *Developing Communication Skills*. Macmillan India Ltd., Chennai. 2001.
4. Raman, Meenakshi & Sharma, Sangeetha. *Technical Communication*. Oxford University Press, 2011.

11MAT1304	BASIC STATISTICS	L	T	P	X	H	C
		2	0	0	3	5	3
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

Objective:

The objective of this course is to provide an understanding for the graduate student on statistical concepts to include data, measurements of location and dispersion, probability, correlation and regression

Course Outcomes:

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

CO1: understand the concept of data and presentation of data

CO2: analyse statistical data using measures of central tendency

CO3: know the concept of various measures of dispersions

CO4: understand the basic concept of probability

CO5: calculate and interpret the correlation and regression between two variables

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1											3	1	
CO2	3	2	1	2									3		2
CO3	3	1	1										3	2	

CO4	3	1	2									3		1
CO5	3	2										3	2	

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Introduction to Statistics **15 Hours**

Definition of Statistics – Scope and Limitations of Statistics – Statistical investigation – Stages in conducting survey – Primary data vs Secondary data – Classification, Tabulation and presentation of data diagram (Simple problems on the above topics)

Unit II: Measures of Central Tendencies **15 Hours**

Measures of Central tendency definition; Types of averages, median, mode, Arithmetic mean, Geometric mean, Harmonic mean, Quadratic mean, Relation between mean, median and mode(Simple problems on the above topics)

Unit III: Measures of Dispersion **15 Hours**

Definition and properties of dispersion – Absolute vs relative measure of dispersion – Skewness, Kurtosis, Range, Quartile deviation, Mean deviation and Standard deviation (Simple problems on the above topics)

Unit IV: Introduction to Probability **15 Hours**

Definitions of Probability – Axioms on probability – Conditional probability (Simple problems on the above topics)

Unit V: Correlation and Regression **15 Hours**

Introduction – Types of correlation – Coefficient of Correlation – Rank Correlation – Regression – Principles of least square techniques – Fitting a straight line – Fitting a second-degree parabola (Simple problems on the above topics)

Text Books:

1. Arumugam and Issac, *Statistics*, New Gamma Publishers, July 2013.
2. A.M. Goon. M.K.Gupta and B.Dasgupta – Fundamentals of Statistics. Vol. I & II.

Reference Books:

1. S.C Gupta- Fundamental of statistics- Himalaya publishing house- 2014.

211CHY1101	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**X**	**H**	**C**
		4	**0**	**0**	**0**	**3**	**3**
Pre-requisite: Basic Knowledge of Chemistry at the higher secondary curse level		**Course Category:** Foundation Core **Course Type**: Theory Course					

Course Outcomes:

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

CO1: Know the importance of environmental studies and methods of conservation of natural resources

CO2: Describe the structure and function of an ecosystem and explain the values and conservation of bio-diversity

CO3: Explain the sources, environmental effects and control measures of various types of pollutions

CO4: Select the appropriate methods for waste management

CO5: Recall social issues and legal provision and describe the necessities for environmental act

Mapping of COs and POs

CO/PO	**PO**	**PSO**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		2									3		1
CO2	3	1	1										3	1	2
CO3	3	1	1	1									3	2	
CO4	2		2										3	1	
CO5	3			1									3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Natural resources **9 Hours**

Environmental Science: Definition, scope, importance and need for public awareness – Natural resources: forest resources, water resources, land resources, mineral resources, food resources and energy resources – Alternate renewable energy resources: Anaerobic digestion, Bio-gas production – Role of alternate renewable energy resources in environmental impact – Role of an individual in conservation of natural resources.

Unit II: Ecosystem and biodiversity **9 Hours**

Ecosystem: Concept of ecosystem and ecology, types of ecosystem, structure of ecosystem (biotic and abiotic components) – Function of an ecosystem: Energy and nutrient flow, biogeochemical cycle (C, N, S and O cycle), food chains, food webs and ecological pyramids.

Biodiversity: Definition, values of biodiversity – Hot spots of biodiversity – Threats to biodiversity – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit III: Environmental pollution **9 Hours**

Sources, consequences and control measures of air pollution, water pollution, soil pollution, thermal pollution and nuclear pollution – Environmental threats: Photochemical smog, London smog, acid rain, climate change, global warming (Greenhouse effect) and ozone layer depletion. – Pollution by trace elements (Hg, As, F, Pb and Cd): Biochemical effects, toxicology, toxicity, control and treatment – Fireworks: current environmental issues.

Unit IV: Management of environmental pollution **9 Hours**

Causes, effects, treatments methods and control measures of solid waste, municipal waste, biomedical waste, E-waste – Removal of heavy metals by adsorption methods: Zeolite process, Ion-Exchange process, ultrafiltration and reverse osmosis – Waste minimization techniques – Cleaner technology -- Disaster management: floods, earthquake, cyclone, landslides and Tsunami.

Unit V: Social issues and the environment **9 Hours**

Water conservation, rain water harvesting- Environmental impact assessment- Precautionary and polluters pay principle- environment protection act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - Population explosion - Family Welfare Programmes - Environment and human health - Human Rights - Women and Child Welfare. Green Campus: Definition, need for green campus, room for improvement (waste water recycling and solar powered appliances).

Reference Books:

1. E.R. Nagarajan and A. Murugan, Environmental Science, Wiley Publishers, New Delhi, 2017
2. S.K. Dhameja, Environmental Engineering and Management, S.K. Kataria and Sons, New Delhi, 2015.
3. A. Kaushik and C.P. Kaushik, Environmental Science & Engineering, New Age international Publishers, New Delhi, 2010.
4. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., 2nd edition, 2004.
5. Erach Bharucha, Textbook for Environmental Studies, UGC, New Delhi, 2004.

211ENG1304	HUMAN VALUES	L	T	P	X	H	C
		2	0	0	3	5	3
Pre-requisite:		**Course Category:** Foundation Core **Course Type**: Theory Course					

Objectives:

- To know about universal human values and understand the importance of values in individual, social circles, career path, and national life.
- To learn from case studies of lives of great and successful people who followed and practised human values and achieved self-actualization.
- To become conscious practitioners of human values.
- To realise their potential as human beings and conduct themselves properly in the ways of the world.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Know about universal human values and understand the importance of values in individual, social circles, career path, and national life.

CO2: Learn from case studies of lives of great and successful people who followed and practised human values and achieved self-actualisation.

CO3: Become conscious practitioners of human values.

CO4: Realise their potential as human beings and conduct themselves properly in the ways of the world.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3		3
CO2	3	1	1										3		
CO3	3	1											3	1	2
CO4	3	3											3	2	1
CO5	3	2	1										3	3	

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I

Values – Meaning and Definition – Types **–** Importance – Love & Compassion **:** Introduction – Meaning – Forms of Love – Love for self, Parents, Family, Friends, Spouse, Community, Nation, Humanity and other beings, both Living and Non living – Interrelation between Love & Compassion – Empathy – Sympathy – Non Violence – Practicing and non Practicing of Love and Compassion.

Unit II

Truth – Introduction – Meaning – Accuracy – Curiosity – discrement – Fairness – Fearlessness –honesty – honesty – integrity (unity of thought, word and deed) – Intution – Justice – Optimisim – Purity – Quest for knowledge – Reason - Self analysis – Sincerity – sprit of Enquiry – Synthesis – Trust – Truthfulness and determination – Practicing and Non Practicing of Truth.

Unit III

Non Violence – Introduction – Meaning – Need of Non Violence – Prerequisites for Non Violence – Ahimsa (Non Violence and Non- killing) – Values related to Non Violenck (Pshychological and Social) – Practicing and Non Practicing of Non Violence

Unit IV

Righteouseness – Introduction – Meaning – Righteouseness and dharma – Righteouseness and propriety – Values related to Righteouseness – Values related to Right Conduct or Righteouseness (Self help skills, Social skills and Ethical skills) – Practicing and Non Practicing of Righteouseness

Unit V

Peace and Services – Introduction – Meaning - Need of Peace – Peace vs harmony and balance – Attention – Calmness – Equality – Equanimity – Faithfulness – Focus – Gratitude – Happiness - humanity – Inner Silence – optimism – Patience – Selfconfidence – Self Control – Self discipline – Self Esteem – Self respect – Self Control – tolerence and Understanding – Practicing and Non Practicing of Peace

Services – Introduction and Meaning – Forms of Services – Service for Self, Parents, Family, Friend, Spouse, Community, Nation, Humanity and other beings—Living and Non-living, Persons in Distress or Disaster – Practicing and Non Practicing of Services.

Renunciation - Introduction – Meaning – Renunciation and sacrifice – Self restrain and ways of overcoming greed – Practicing and Non Practicing of Renunciation

Reference Books:

1. Joshi Rokeach (1973). The Nature of Human Values. New York: The Free Press
2. R S Nagarazan (2006) A text book of professional ethics and Human values, New age international publishers

PROGRAM CORE COURSES

212MAT2101	Set Theory	L	T	P	X	H	C
		5	1	0	0	6	6

COURSE OBJECTIVE

To qualify the students to understand the central conceptions of Sets, Relations and Number theory and apply them to solve real life problems.

COURSE OUTCOMES

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

1. describe memberships of sets, including the empty set, using proper notation, and decide whether given items are members and determine the cardinality of a given set.
2. illustrate the relations between sets regarding membership, equality, subset, and proper subset, using proper notation.
3. be able to recognize the properties and arithmetic of Natural Numbers and Sets.
4. express the Properties, operations and arithmetic of Cardinal and Ordinal Numbers.
5. depict the Recursions, Normal forms of Ordinals and Cardinals. Also about the models of sets.

CO – PO MAPPING

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1		M										L
CO 2	S		S									
CO 3			M									L
CO 4	S											
CO 5		L										

*S – Strong; M – Medium; L – Low

UNIT-I: Historical Introduction	
Background, Paradoxes, Axiomatic method, axiomatic set theory Objections to axiomatic approach and other proposals, classes and sets, building sentences, building classes, algebra of classes, ordered pairs and cartesian Products, graphs, generalized unions and intersections, sets, Functions: Introduction, Fundamental Concepts, Properties of composite functions and inverse functions, Direct Images and Inverse Images under functions, Product of a family of classes, axiom of replacement.	

UNIT-II: Relations and Functions	
Relations: Introduction, Fundamental Concepts, Equivalence Relations and partitions, Pre-Image Restrictions, and quotients of Equivalence Relations, Equivalence Relations and Functions Partially ordered classes: Fundamental concepts, order preserving functions and isomorphism Distinguished elements and duality, Lattices, Fully ordered classes and well ordered classes, isomorphism between well-ordered classes, Axiom of choice and Applications, Maximal Principles, Well-Ordering Theorems.	
UNIT-III: Natural Numbers	
Natural Numbers: Introduction, Elementary Properties, Finite Recursion, Arithmetic of Natural Numbers, Finite and Infinite sets: Introduction, Equipotence of Sets, Properties of Infinite Sets, Properties of Denumerable sets.	
UNIT-IV: Cardinal and Ordinal Numbers	
Arithmetic of Cardinal Numbers: Introduction, Operations on Cardinal Numbers, Ordering of the Cardinal Numbers, Special properties of the Infinite Cardinal Numbers, Infinite Sums and Products of Cardinals Numbers, Arithmetic of Ordinal Numbers,: Introduction, Operations on Ordinal numbers, Ordering of the Ordinal Numbers, The alephs and the continuum hypothesis, Construction of the Ordinals and Cardinals.	
UNIT-V: Transfinite Recursion, Consistency and Independence	
Transfinite Recursion, Properties of Ordinal Exponentiation, Normal Form, Epsilon Numbers, Inaccessible Ordinals and Cardinals, What is a Set? Models, Independence Results in Set Theory, The Question of Models of Set Theory, Properties of The Constructible Universe, The Godel Theorems.	
TEXT BOOK(S)	
CHARLES C. PINTER, A Book of SET THEORY, DOVER PUBLICATIONS, INC. Mineola New York, 2014. • Unit-I: Chapters 0, 1 and 2; • Unit-II: Chapters 3, 4 and 5; • Unit-III: Chapters 6 and 7; • Unit-IV: Chapters 8 and 9; • Unit-V: Chapters 10 and 11	
REFERENCE BOOK(S)	
1. Bourbaki, N., Théorie des Ensembles, Paris, Hermann, 1963. 2. Fraenkel, A. A., Set Theory and Logic, Reading, Mass., Addison-Wesley, 1966. 3. Halmos, P., Naive Set Theory, Princeton, Van Nostrand, 1960. 4. Kamke, E., Theory of Sets, New York, Dover, 1950. 5. Monk, J. D., Introduction to Set Theory, New York, McGraw-Hill, 1969. 6. Quine, W. V., Mathematical Logic, Cambridge, Mass., Harvard University Press, 1951. 7. Rubin, J. E., Set Theory for the Mathematician, San Francisco, Holden-Day, 1966. 8. Slupecki, J. and L. Borkowski, Elements of Mathematical Logic and Set Theory, Oxford, Pergamon Press, 1967. 9. Suppes, P., Introduction to Logic, Princeton, Van Nostrand, 1957. 10. Suppes, P., Axiomatic Set Theory, Princeton, Van Nostrand, 1960	

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212MAT2102	Differential and Integral Calculus	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

To introduce and acquire knowledge in basic integral and differential calculus.

COURSE OUTCOMES

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

1. understand the basic idea and Properties of definite integrals and indefinite integrals
2. know about the methods of integration and the notion of improper integrals
3. to identify the concept of Taylor's series, Binomial series and indeterminate expressions
4. have a detailed study on numerical integration and numerical solution of equations
5. learn about the concept of functions of several variables.

CO – PO MAPPING

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1		M										L
CO 2	S											
CO 3		M										
CO 4	S											L
CO 5		L										

*S – Strong; M – Medium; L – Low

UNIT-I: Fundamentals of Differentiation and Integration	
Fundamental Ideas, Definite Integral, Derivative, Indefinite Integral, Simple Methods of Graphical Integration, Connection between integral and Derivative, Estimation of Integrals, Mean value Theorem of Integral Calculus, The Existence of the Definite Integral of a Continuous Function, . The Relation between the Mean Value Theorem of the Differential Calculus and the Mean Value Theorem of the Integral Calculus, Differentiation and Integration of elementary Functions, Some Special Functions, Remarks on the Differentiability of Functions, Some Special Formulae.	
UNIT-II: Methods of Differentiation and Integration	
Further Development Of The Integral Calculus, Method of substitution, Integration by Parts, Integration of rational and other special classes of functions, Functions which are not Integrable in Terms of Elementary Functions, Improper Integrals, The Second Mean Value Theorem of the	

Integral Calculus, Representation of Curves, Applications to the Theory of Plane Curves, Some very Simple Problems in the Mechanics of a Particle, Particle sliding down a Curve, Work, Properties of the Evolute, Areas bounded by Closed Curves.
UNIT-III: Applications of Calculus
The Logarithm and the Inverse Tangent, Taylor's Theorem, Expansions of the Elementary Functions, Geometrical Applications, Example of a Function which cannot be expanded in a Taylor Series, Proof that e is Irrational, Proof that the Binomial Series Converges, Zeros and Infinities of Functions, and So-called Indeterminate Expressions.
UNIT-IV: Numerical Integration
Numerical Integration, Applications of the Mean Value Theorem and of Taylor's Theorem. The Calculus of Errors Numerical Solution of Equations, Stirling's Formula.
UNIT-V: Fundamentals of Several Variable Calculus
The Concept of Function in the Case of Several Variables, Continuity, The Derivatives of a Function of Several Variables, The Chain Rule and the Differentiation of Inverse Functions, Implicit Functions, Multiple and Repeated Integrals.
TEXT BOOK(S)
R. COURANT , DIFFERENTIAL AND INTEGRAL CALCULUS , SECOND EDITION Wiley Classics Library Edition Published 1988 • Unit-I: Chapters 2 and 3; • Unit II: Chapters 4 and 5; • Unit III: Chapters 6; • Unit –IV: Chapter 7; • Unit V: Chapter 10;
REFERENCE BOOK **1.**George A. Osborne, S.B., Differential And Integral Calculus With Examples And Applications, Revised Edition Boston, U.S.A. D. C. Heath & Co., Publishers 1906.

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212MAT2104	DIFFERENTIAL EQUATIONS	L	T	P	X	H	C
		5	1	0	0	6	6

COURSE OBJECTIVE

To provide students with an introduction to the theory of ordinary differential equationsand various methods of solution.

COURSE OUTCOMES

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

1. recognize and solve linear, separable and exact first-order differential equations
2. understand the methods in solving the first order higher degree differential equations.
3. know about the method of solving higher order differential equations
4. know the concept of principle of superposition and general solution.
5. obtain series solution of differential equations.

CO - PO MAPPING

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1		M										L
CO 2	S											
CO 3		M										
CO 4	S											L
CO 5		L										

*S – Strong; M – Medium; L – Low

UNIT-I: Basics of Ordinary Differential Equations	
Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogenous equations. Exact equations. Integrating factor. Linear equations.	
UNIT-II: First Order Ordinary Differential Equations	
First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existenceand uniqueness of the solutions of the first order differential equations.	
UNIT-III: Second Order Ordinary Differential Equations	

Second order linear differential equation's introduction. General solution of homogenous equations. Homogeneous equation with constant coefficients- Transformations of the equation by changing the dependent/independent variable, Method of undetermined coefficients; Reduction of order, Method of variation of parameters
UNIT-IV: Theory of Linear Differential Equations
Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous equations of higher order with constant coefficients.
UNIT-V: Applications of Differential Equations to Special Functions
Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.
TEXT BOOK(S)
1. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3rd edition). CRC Press. Taylor & Francis.
REFERENCE BOOK(S)
1. B. Rai, D. P. Choudhury & H. I. Freedman (2013). *A Course in Ordinary Differential Equations* (2nd edition). Narosa. 2. Shepley L. Ross (2007). *Differential Equations* (3rd edition), Wiley India.

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		L	T	P	X	H	C
212MAT2103	LINEAR PROGRAMMING	5	1	0	0	6	6

COURSE OBJECTIVE

To enable the students to acquire the knowledge of optimization techniques to solve the real world problems.

COURSE OUTCOMES

1. upon successful completion of this course, the students will be able to
2. understand the basic concepts of Linear Programming Problem
3. study about the Duality and its applications
4. have a detailed study on the technique of simplex method
5. know the concept of factorization process and problems in general form, primal and dual simplex methods.
6. understand the concept of game theory

CO - PO MAPPING

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12

CO 1		M									L
CO 2	S		M								
CO 3		M								L	
CO 4	S										L
CO 5		L									

*S – Strong; M – Medium; L – Low

UNIT-I: Basics of Linear Programming	
Introduction, Simplex Method, Initialization, Unboundedness, Geometry, Degeneracy, Perturbation/Lexicographic Method, Bland's Rule, Fundamental Theorem of Linear Programming, Geometry	
UNIT-II: Concept of Duality in Linear Programming	
Efficiency of Simplex Method, performance Measures, Measuring the size of a problem, Measuring the effort to solve a problem, Worst case analysis of the Simplex method, Duality Theory, Weak Duality Theorem, Strong Duality Theorem, Complementary Slackness, Dual Simplex Method, Dual Based Phase-I Algorithm, Dual of a Problem in General Form, Resource Allocation Problem, Lagrangian Duality	
UNIT-III: Various Solution Techniques of Linear Programming	
Simplex Method in Matrix Notation, Primal Simplex Method, Dual Simplex Method, Two-Phase Method Negative Transpose Property, Sensitivity Analysis, Parametric Analysis, Homotopy Method, Parametric Self-Dual Simplex Method	
UNIT-IV: Implementation Issues and beyond	
Implementation Issues, LU Factorization, Exploiting Sparsity, Reusing a Factorization, Performance Tradeoffs, Updating a Factorization, Shrinking the Bump, Partial Pricing, Steepest Edge, Problems in General Form, Primal and Dual Simplex Methods	
UNIT-V: Convex Analysis and Optimal Strategies	
Convex Analysis, Convex Sets, Caratheodory's Theorem, Separation Theorem, Farkas' Lemma, Strict Complemaentarity, Game Theory, Matrix Games, Optimal Strategies, Minimax Theorem, Poker	
TEXT BOOK(S)	
1. Robert J. Vanderbei, Linear Programming: Foundations and Extensions, Second Edition, Copyright c 2001 by Robert J. Vanderbei. All rights reserved. Printed in the United States of America. 2001. • Unit-I: Chapters 1,2 and 3; • Unit-II: Chapters 4 and 5; • Unit-III: Chapters6 and 7; • Unit-IV: Chapters8 and 9; • Unit-V: Chapters 10 and 11	
REFERENCE BOOKS	

1. V. Chvátal, Linear Programming. New York: W. H. Freeman, 1983.2. Schrijver, A. *The theory of Integer and Linear programming* Addison Wesley, 1998.
2.Alon, N., Spencer, *The Probabilistic Method*, John Wiley, 19914.G. Strang, Linear Algebra and its Applications, 3rd ed. San Diego: Harcourt Brace Jovanovich, 1988

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212MAT2105	**Elementary Algebra**	L	T	P	X	H	C
		3	1	0	0	4	4

Course objective:

To acquire a basic understanding of linear equations (and inequalities) in two variables, including their graphs. To solve a system of linear equations in two variables by various methods. To develop a basic ability to solve applications using the algebraic techniques covered throughout the course.

Course Outcomes:

Upon successful completion of this course, students will be able to
1. familiar with various Real number sets, including the Integers and Rational numbers.
2. acquire skill in solving first degree equations (and inequalities) in one variable.
3. acquire a basic understanding of linear equations (and inequalities) in two variables
4. solve a system of linear equations in two variables by various methods.
5. develop a basic ability to solve applications using the algebraic techniques

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			S								S
CO2		S									S	
CO3	S		S		S							S
CO4	S										S	
CO5	S	S	S	M								S

S- Strong; M-Medium; L– Low.

UNIT-I: Roots of Equations and constructions	**(18 Hours)**
Fundamental Theorem of Algebra, Relations between Roots and Coefficients, Imaginary roots occur in pairs, Upper limit to the real roots, Integral roots, Newton's method, Rational roots, Impossible constructions, Analytic criterion of constructability, cubic equations with constructible root, trisection of an angle, duplication of a cube, regular polygon of seven sides and roots of unity, reciprocal equations, periods of roots of unity,	
UNIT-II: Cubic and Quartic Equations	**(18 Hours)**

Reduced cubic equations, Algebraic solution of a cubic, Discriminant, Number of real roots of a cubic irreducible case, trigonometric solution of a cubic, Ferrari's solution of the quartic equation, resolvent cubic, Descarte's solution of the quartic equation, symmetrical form of Descarte's solution
UNIT-III: Isolation of Real Roots and Solutions **(18 Hours)**
Purpose and Methods of Isolating the real roots, Descarte's rule of signs, Sturm's method, Sturm's Theorem, Simplifications of Sturm's functions, Sturm's functions for a quartic equation, Sturm's Theorem for multiple roots, Budan's Theorem, Horner's Method, Newton's Method
UNIT-IV: Symmetric Functions **(18 Hours)**
Sigma Functions, Elementary Symmetric Functions, Fundamental Theorem, Functions symmetric in all but one root, Sums of Like Powers of the roots, Waring's Formula, Computation of Sigma Functions, Computation of Symmetric functions
UNIT-V: Eliminations, Resultants and Discriminants **(18 Hours)**
Elimination, Resultant of Two Polynomials, Sylvestor's Method of elimination, Bezout's method of elimination, General Theorem on Elimination, Discriminants, Fundamental Theorem of Algebra
TEXT BOOK(S) 1.LEONARD EUGENE DICKSON, FIRST COURSE IN THE THEORY OF EQUATIONS, JOHN WILEY & SONS, Inc., 1922 Unit-I: Chapter 2, 3; Unit-II: Chapter 4 ; Unit-III: Chapter 6, 7; Unit-IV: Chapter 9 ; Unit-V: Chapter 10 and Appendix (In all the chapters said above only topics mentioned here)
REFERENCE BOOKS 1 Carl Stitz, Jeff Zeager, College Algebra, Version $\sqrt{3}$ = 1.7320508075688772 . . ., June 29, 2010

Elementary Algebra – MAT21RXXX

Week	Unit	Lecture Topic
1-3	**Unit – 1**	➢ Fundamental Theorem of Algebra, ➢ Relations between Roots and Coefficients, Imaginary roots occur in pairs, ➢ Upper limit to the real roots, Integral roots, Newton's method, Rational roots, ➢ Impossible constructions, Analytic criterion of constructability ➢ cubic equations with constructible root, trisection of an angle ➢ duplication of a cube, regular polygon of seven sides and roots of unity, reciprocal equations, periods of roots of unity,
4-6	**Unit – 2**	➢ Reduced cubic equations, Algebraic solution of a cubic ➢ Discriminant, Number of real roots of a cubic, irreducible case ➢ trigonometric solution of a cubic ➢ Ferrari's solution of the quartic equation, resolvent cubic ➢ Descarte's solution of the quartic equation, symmetrical form of Descarte's solution
7-9	**Unit – 3**	➢ Purpose and Methods of Isolating the real roots, ➢ Descarte's rule of signs, Sturm's method, ➢ Sturm's Theorem, Simplifications of Sturm's functions, ➢ Sturm's functions for a quartic equation, Sturm's Theorem for multiple roots,

		➢ Budan's Theorem, Horner's Method, Newton's Method
10-12	**Unit – 4**	➢ Sigma Functions, Elementary Symmetric Functions ➢ Fundamental Theorem, Functions symmetric in all but one root, ➢ Sums of Like Powers of the roots, ➢ Waring's Formula, Computation of Sigma Functions ➢ Computation of Symmetric functions
13-15	**Unit – 5**	➢ Elimination, Resultant of Two Polynomials, ➢ Sylvestor's Method of elimination, ➢ Bezout's method of elimination, ➢ General Theorem on Elimination, Discriminants, ➢ Fundamental Theorem of Algebra

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213MAT2101	**Mathematical Modelling**	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

The objective of this course is to make the students understand the concept of 'systems' and enable them to build mathematical models using difference equations to solve real life problems.

COURSE OUTCOMES

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

CO1 understand the basic ideas of 'systems' and how these systems behave.

CO2 model a variety of systems of interest in the social and life sciences, ranging from population models to anthropology using some relatively simple mathematics.

CO3 learn the standard types of first and second order linear and affine autonomous difference equations and how to set up equations.

CO4 analyze the stability in the simplest cases.

CO5 know about prey-predator systems, unemployment problem and learn how to turn a second order equation in one variable into a first order system in two.

CO – PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S			M	S						
CO3	S											
CO4		S	M									

CO5	**M**					**S**						**L**

*S – Strong; M – Medium; L – Low

UNIT-I: Fundamentals	**(18 Hours)**
Systems and States, Idealisations, Real Numbers and Guns, Bacteria and People, How to do it yourself	
UNIT-II: Growth	**(18 Hours)**
Bacteria, People, Money, Logistic Equation Revisited, Death and Taxes, Money, Of Mice and Men, And Rats and Women, History: Truth, Lies and Radioactivity	
UNIT-III: A Menagerie of Difference Equations	**(18 Hours)**
Some Definitions, Linear and Affine Difference Equations, First Order Difference Equations, Second Order Difference Equations,	
UNIT-IV: Iterates of Maps: Stability	**(18 Hours)**
Cobwebs and Chaos, More about stability, Heartbeats	
UNIT-V: Higher Dimensional Systems	**(18 Hours)**
Eating People is Wrong, But Killing them in War is OK, The Dismal Science, A cheap Trick	
TEXT BOOK(S)	
1. Michael D Alder, An Introduction to Mathematical Modelling, HeavenForBooks.com, This Edition © Michael D Alder, 2001 Unit I: Chapter 1; Unit II: Chapter 2; Unit III: Chapter 3; Unit IV: Chapter 4; Unit V: Chapter 5;	
REFERENCE BOOKS 1. Gerhard Dangelmayr and Michael Kirby, MATHEMATICAL MODELING A Comprehensive Introduction, PRENTICE HALL, Upper Saddle River, New Jersey 07458	

Mathematical Modelling – MAT21RXXX

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Systems and States
2		➢ Idealisations,
3		➢ Real Numbers and Guns, ➢ Bacteria and People, ➢ How to do it yourself
4	**Unit – 2**	➢ Bacteria, People, Money,
5		➢ Logistic Equation Revisited
6		➢ Death and Taxes, ➢ Money, Of Mice and Men, And Rats and Women, ➢ History: Truth, Lies and Radioactivity
7	**Unit – 3**	➢ Some Definitions, ➢ Linear and Affine Difference Equations
8		➢ First Order Difference Equations,

9		➢ Second Order Difference Equations,
10	**Unit – 4**	➢ Cobwebs and Chaos, ➢ More about stability, ➢ Heartbeats
13	**Unit – 5**	➢ Eating People is Wrong, , The Dismal Science,
14		➢ But Killing them in War is OK
15		➢ A cheap Trick

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212MAT1301	**Integral Transforms**	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

To enable the students to understand the basic concepts of continuous integral transforms such as Fourier and Laplace Transforms, discrete transform such as Z-transform and their applications.

COURSE OUTCOMES

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

CO1 know about Fourier transforms and its properties.

CO2 solve partial differential equations using Fourier Sine and Cosine transforms

CO3 understand Laplace transform and inverse Laplace transform with its properties

CO4 solve differential equations using Laplace transforms and its properties

CO5 implement Z- transform and its properties to solve finite difference equations.

CO – PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**S**	**M**										
CO2	**M**	**S**										**L**
CO3	**S**	**M**										
CO4	**M**	**S**										**L**
CO5	**S**	**M**										

*S – Strong; M – Medium; L - Low

UNIT-I: Fourier Transforms	**(18 Hours)**

Introduction, The Fourier Integral Formulas, Definition of the Fourier Transform and Examples, Fourier Transforms of Generalized Functions, Basic Properties of Fourier Transforms, Poisson's Summation Formula, The Shannon Sampling Theorem, The Gibbs Phenomenon, Heisenberg's Uncertainty Principle.	
UNIT-II: Applications of Fourier Transforms	**(18 Hours)**
Applications of Fourier Transforms to Ordinary Differential Equations, Solutions of Integral Equations, Solutions of Partial Differential Equations, Fourier Cosine and Sine Transforms with Examples, Properties of Fourier Cosine and Sine Transforms, Applications of Fourier Cosine and Sine Transforms to Partial Differential Equations, Evaluation of Definite Integrals, Applications of Fourier Transforms in Mathematical Statistics, Multiple Fourier Transforms and Their Applications	
UNIT-III: Laplace Transforms	**(18 Hours)**
Introduction, Definition of the Laplace Transform and Examples, Existence Conditions for the Laplace Transform, Basic Properties of Laplace Transforms, The Convolution Theorem and Properties of Convolution, Differentiation and Integration of Laplace Transforms, The Inverse Laplace Transform and Examples, Tauberian Theorems and Watson's Lemma	
UNIT-IV: Applications of Laplace Transforms	**(18 Hours)**
Introduction, Solutions of Ordinary Differential Equations, Partial Differential Equations, Initial and Boundary Value Problems, Solutions of Integral Equations , Solutions of Boundary Value Problems, Evaluation of Definite Integrals, Solutions of Difference and Differential-Difference Equations, Applications of the Joint Laplace and Fourier Transform, Summation of Infinite Series , Transfer Function and Impulse Response Function of a Linear System, The Double Laplace Transform, Functional and Partial Differential Equations.	
UNIT-V: Z Transforms	**(18 Hours)**
Introduction, Dynamic Linear Systems and Impulse Response, Definition of the Z Transform and Examples , Basic Operational Properties of Z Transforms, The Inverse Z Transform and Examples, Applications of Z Transforms to Finite Difference Equations, Summation of Infinite Series	
TEXT BOOK(S)	
1. Lokenath Debnath and Dambaru Bhatta, Integral Transforms and Their Applications, THIRD EDITION, CRC Press Taylor & Francis Group, 2015 Unit I: Chapter 2, 2.1 to 2.9; Unit II: Chapter 2, 2.10 to 2.18; Unit III: Chapter 3, 3.1 to 3.8; Unit IV: Chapter 4, 4.1 to 4.11; Unit V: Chapter 12, 12.1 to 12.7	
REFERENCE BOOKS	
1. Dimitris N. Chorafas, Integral Transforms and Their Applications, Chapman & Hall/CRC Taylor & Francis Group, 2007.	

Integral Transforms – MAT21RXXX

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Introduction, ➢ The Fourier Integral Formulas, ➢ Definition of the Fourier Transform and Examples, ➢ Fourier Transforms of Generalized Functions, Basic Properties of Fourier Transforms, ➢ Poisson's Summation Formula,

		➢ The Shannon Sampling Theorem, ➢ The Gibbs Phenomenon, Heisenberg's Uncertainty Principle .
4	**Unit – 2**	➢ Applications of Fourier Transforms to Ordinary Differential Equations, ➢ Solutions of Integral Equations, ➢ Solutions of Partial Differential Equations, ➢ Fourier Cosine and Sine Transforms with Examples, ➢ Properties of Fourier Cosine and Sine Transforms, ➢ Applications of Fourier Cosine and Sine Transforms to Partial Differential Equations, ➢ Evaluation of Definite Integrals, ➢ Applications of Fourier Transforms in Mathematical Statistics, ➢ Multiple Fourier Transforms and Their Applications
7	**Unit – 3**	➢ Introduction, Definition of the Laplace Transform and Examples, ➢ Existence Conditions for the Laplace Transform, Basic Properties of Laplace Transforms, ➢ The Convolution Theorem and Properties of Convolution ➢ Differentiation and Integration of Laplace Transforms, ➢ The Inverse Laplace Transform and Examples, ➢ Tauberian Theorems and Watson's Lemma
10	**Unit – 4**	➢ Solutions of Ordinary Differential Equations, Partial Differential Equations, Initial and Boundary Value Problems, ➢ Solutions of Integral Equations , Solutions of Boundary Value Problems, ➢ Evaluation of Definite Integrals, ➢ Solutions of Difference and Differential-Difference Equations, Applications of the Joint Laplace and Fourier Transform ➢ Summation of Infinite Series, ➢ Transfer Function and Impulse Response Function of a Linear System, ➢ The Double Laplace Transform, Functional and Partial Differential Equations.
13	**Unit – 5**	➢ Dynamic Linear Systems and Impulse Response, Definition of the Z Transform and Examples , ➢ Basic Operational Properties of Z Transforms, The Inverse Z Transform and Examples, ➢ Applications of Z Transforms to Finite Difference Equations, Summation of Infinite Series

212MAT2106	**Modern Algebra**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective:

To enable the students to acquire the basic knowledge in groups, rings and fields.

Course Outcome(s):

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

CO1 discuss about the concepts such as morphisms, cosets and types of groups.
CO2 utilize the concepts of symmetric groups and free groups.
CO3 understand the concept of linear groups.
CO4 describe the concepts of Rings and Ideals
CO5 demonstrate the concept of fields and finite fields.

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**S**	**M**										**L**
CO2	**S**	**S**	**S**									
CO3	**S**		**M**									**L**
CO4	**S**											
CO5	**S**	**L**										**L**

*S – Strong; M – Medium; L – Low

UNIT-I: Fundamentals of Group Theory	**(18 Hours)**
Groups and Subgroups, Homomorphisms, Isomorphisms, Cosets, Modular Arithmetic, Product Groups, Quotient Groups	
UNIT-II: Symmetric Groups and Free Groups	**(18 Hours)**
Cayley's Theorem, The Class Equation, p-Groups, The Class Equation of the Icosahedral Group Conjugation in the Symmetric Group, Normalizers. The Sylow Theorems Groups of Order 1 2 , The Free Group Generators and Relations, The Todd-Coxeter Algorithm	
UNIT-III: Linear Groups	**(18 Hours)**
The Classical Groups, Interlude: Spheres, The Special Unitary Group SU_2, The Rotation Group SO_3 One-Parameter, Groups, The Lie Algebra, Translation in a Group, Normal Subgroups of S L_2	
UNIT-IV: Ring Theory	**(18 Hours)**
Rings, Polynomial Rings, Ideals, Quotient Rings, Product Rings, Integral Domains, Fraction Fields, Maximal Ideals	
UNIT-V: Field Theory	**(18 Hours)**

Fields, Algebraic and Transcendental elements, Degree of a Field Extension, Construction with Ruler and Compass, Symbolic Adjunction of Roots, Finite Fields
TEXT BOOK(S)
Michael Artin, Algebra, Prentice Hall, 1991. Unit-I: Chapter 2; Unit-II: Chapter 7; Unit-III: Chapter 9 ; Unit-IV: Chapter 11; Unit-V: Chapter 15
REFERENCE BOOKS 1.Jacobson, N., *Basic Algebra I, II*, Hindustan Publishing Corporation, 1991. 2.P. R. Halmos, *Finite-dimensional Vector Spaces*, Springer.2000

Modern Algebra – MAT21RXXX

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Groups and Subgroups, Homomorphisms, Isomorphisms
2		➢ Cosets, Modular Arithmetic
3		➢ Product Groups, Quotient Groups
4	**Unit – 2**	➢ Cayley's Theorem, The Class Equation, p-Groups, The Class Equation of the Icosahedral Group,
5		➢ Conjugation in the Symmetric Group, Normalizers. The Sylow Theorems Groups of Order 1 2
6		➢ The Free Group Generators and Relations, The Todd-Coxeter Algorithm
7	**Unit – 3**	➢ The Classical Groups, Interlude: Spheres, One-Parameter, Groups,
8		➢ The Special Unitary Group SU_2, The Rotation Group SO_3,
9		➢ The Lie Algebra, Translation in a Group, Normal Subgroups of ➢ SL_2
10	**Unit – 4**	➢ Rings, Polynomial Rings ➢ Ideals, Quotient Rings ➢ Product Rings ➢ Integral Domains
11		➢ Fraction Fields
12		➢ Maximal Ideals
13	**Unit – 5**	➢ Fields, Algebraic and Transcendental elements
14		➢ Degree of a Field Extension, Construction with Ruler and Compass
15		➢ Symbolic Adjunction of Roots, Finite Fields

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214MAT1301	**Fourier Series and Applications**	L	T	P	X	H	C
		3	1	0	0	4	4

Course objective:

Students will be familiar with Fourier series and their applications and be notionally aware of their convergence. Students will know how to derive the heat, wave and Laplace's equations in several independent variables and to solve them. They will begin the study of uniqueness of solution of these important PDEs.

Course Outcomes:

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

1. represent continuous-time periodic signals using Fourier series.
2. understand the properties of Fourier series.
3. understand the relationship between Fourier series and linear time-invariant system.
4. write given function in terms of sine and cosine terms in Fourier series and also to get knowledge in Fourier transforms.
5. determining the Fourier series of a discrete time periodic signal.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M									S
CO2		S		S						M		
CO3												
CO4	S	S						S			S	
CO5	S	S									S	

S- Strong; M-Medium; L– Low.

UNIT-I: Introduction to Fourier Series	**(18 Hours)**
Heuristic Derivations, Frequencies, Coefficients, Defining the Trignometric Fourier Series, Computing the Fourier Coefficients, Partial Sums and Graphing, Basic Fourier Series, The Sine Series, Cosine Series, Using these series,	
UNIT-II: Complex Fourier Series	**(18 Hours)**
Derivation, Notation and Terminology, Computing the Coefficients, Partial Sums, Convergence and Fourier's Conjecture, Pointwise Convergence, Uniform and Non uniform Approximations, Convergence in Norm, The Sine and Cosine Series, Basic Theorem on Pointwise Convergence, Convergence for a Particular Saw Function, Convergence for Arbitrary Saw Functions, Derivatives and Integrals of Fourier Series Differentiation of Fourier Series, Differentiability and Convergence . Integrating Periodic Functions and Fourier Series.	

UNIT-III: Fourier Series to One Dimensional Wave Equation	**(18 Hours)**
Introduction, The One-Dimensional Wave Equation, Boundary Conditions, Initial Conditions, Introduction to the Solution of the Wave Equation, The Fixed End Condition String, The Free End Conditions Problem The Mixed End Conditions Problem.	
UNIT-IV: More About One Dimensional Wave Equation	**(18 Hours)**
Generalizations on the Method of Separation of Variables, Sturm-Liouville Theory, The Frequency Domain Interpretation of the Wave Equation, The D'Alembert Solution of the Wave Equation, The Effect of Boundary Conditions	
UNIT-V: Fourier Series to Two-Dimensional Wave Equation	**(18 Hours)**
Introduction. The Rigid Edge Problem, Frequency Domain Analysis, Time Domain Analysis, The Wave Equation in Circular Regions, Symmetric Vibrations of the Circular Drum, Frequncy Domain Analysis of the Circular Drum, Time Domain Analysis of the Circular Membrane	
TEXT BOOK(S) **1.** KENNETH B. HOWELL, Principles of Fourier Analysis, CHAPMAN & HALL/CRC, 2001 Unit-I: Chapter II, Sections 8 to 10; Unit-II: Chapter II, Sections 12 to 15 ; 2. Arthur L. Schoenstadt, An Introduction to Fourier Analysis Fourier Series, Partial Differential Equations and Fourier Transforms, c 1992 - Professor Arthur L. Schoenstadt, 1992 Unit-III: Chapter 3, Sections 3.1 to 3.8; Unit-IV: Chapter 3, Sections 3.9 to 3.13 ; Unit-V: Chapter 4	
REFERENCE BOOKS **1**.Murray R.Spiegel, Schaum's outline of Theory and Problems of Fourier Analysis with Applications to boundary Value Problems, McGRAW Hill Book Company, 1974	

Fourier Series and Applications – MAT21RXXX

Week	Unit	Lecture Topic
1=3	**Unit – 1**	➢ Heuristic Derivations, Frequencies, ➢ Coefficients, Defining the Trignometric Fourier Series ➢ Computing the Fourier Coefficients, ➢ Partial Sums and Graphing, ➢ Basic Fourier Series, ➢ The Sine Series, Cosine Series, ➢ Using these series,
4-6	**Unit – 2**	➢ Derivation, Notation and Terminology, ➢ Computing the Coefficients, Partial Sums, ➢ Convergence and Fourier's Conjecture, ➢ Pointwise Convergence, Uniform and Non uniform Approximations, ➢ Convergence in Norm, The Sine and Cosine Series, ➢ Basic Theorem on Pointwise Convergence, ➢ Convergence for a Particular Saw Function, ➢ Convergence for Arbitrary Saw Functions, ➢ Derivatives and Integrals of Fourier Series, ➢ Differentiation of Fourier Series, Differentiability and Convergence ➢ Integrating Periodic Functions and Fourier Series.
7-9	**Unit – 3**	➢ Introduction, The One-Dimensional Wave Equation, ➢ Boundary Conditions, Initial Conditions, ➢ Introduction to the Solution of the Wave Equation, ➢ The Fixed End Condition String,

		➢ The Free End Conditions Problem, ➢ The Mixed End Conditions Problem.
10-12	**Unit – 4**	➢ Generalizations on the Method of Separation of Variables ➢ , Sturm-Liouville Theory, ➢ The Frequency Domain Interpretation of the Wave Equation ➢ The D'Alembert Solution of the Wave Equation, ➢ The Effect of Boundary Conditions
13-15	**Unit – 5**	➢ Introduction ➢ The Rigid Edge Problem, ➢ Frequency Domain Analysis, Time Domain Analysis , ➢ The Wave Equation in Circular Regions, ➢ Symmetric Vibrations of the Circular Drum, ➢ Frequncy Domain Analysis of the Circular Drum, ➢ Time Domain Analysis of the Circular Membrane

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213MAT2102	**Mathematical Biology**	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

The objective of this course is to make the students understand the concept of "Population dynamics" using systems of nonlinear Ordinary and Partial Differential equations. Also enable students to build mathematical models on transmission mechanisms of infectious disease and its control strategies. It introduces the fundamental concept of modelling some biological phenomenon using mathematical tools.

COURSE OUTCOMES

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

CO1 understand the basic framework for 'Population dynamics'

CO2 model a variety of infectious diseases transmission based on their characteristics.

CO3 learn posing control strategies to eradicate an infectious disease also predicts the future course of the same.

CO4 analyse the underlying transmission mechanism and asymptotic stability criterion of the steady states of the proposed epidemic models.

CO5 know about epidemic models, law of mass actions, dynamic Programming etc.

CO – PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2			S		M							

CO3		**M**	**S**		**S**						
CO4		**M**	**S**								
CO5			**S**								

*S – Strong; M – Medium; L – Low

UNIT-I: Age-structured Populations	**(18 Hours)**
Malthusian Growth Model, Logistic Equation, A Model of Species Competition, The Lotka-Volterra Predator-prey Model, Fibonacci rabbits, Golden Ratio φ, Fibonacci Numbers in a sun flower, rabbits are an age-structured population, Discrete and Continuous Age-Structured populations, The Brood size of a hermaphroditic worm	
UNIT-II: Infectious Disease Modeling	**(18 Hours)**
SI Model, SIS Model, SIR epidemic disease model, Vaccination, SIR Endemic disease model, Evolution of Virulence	
UNIT-III: Population Genetics	**(18 Hours)**
Haploid Genetics, Diploid Genetics, Frequency Dependent Selection, Linkage Equilibrium, Random Genetic Drift	
UNIT-IV: Bio Chemical Reactions	**(18 Hours)**
Law of Mass Action, Enzyme Kinetics, Competitive Inhibition, Allosteric Inhibition, Cooperativity	
UNIT-V: Sequence Alignment	**(18 Hours)**
DNA, Brute Force Alignment, Dynamic Programming, Gaps, Local Alignments, Software	
TEXT BOOK(S) **1.** Jeffrey R. Chasnov, Mathematical Biology, Copyright ○c 2009–2016 by Jeffrey Robert Chasnov 1Unit-I: Chapter 1, 2; Unit-II: Chapter 4 ; Unit-III: Chapter 5; Unit-IV: Chapter 6 ; Unit-V: Chapter 7	
REFERENCE BOOKS **1.** J.D. Murray, Mathematical Biology, Third Edition, Springer 2001	

Mathematical Biology – 213MAT2102

Week	**Unit**	**Lecture Topic**
1=3	**Unit – 1**	➢ Malthusian Growth Model, ➢ Logistic Equation, ➢ A Model of Species Competition, ➢ The Lotka-Volterra Predator-prey Model, ➢ Fibonacci rabbits, Golden Ratio φ, ➢ Fibonacci Numbers in a sun flower, rabbits are an age-structured population, ➢ Discrete and Continuous Age-Structured populations, ➢ The Brood size of a hermaphroditic worm
4-6	**Unit – 2**	➢ SI Model, ➢ SIS Model, ➢ SIR epidemic disease model, ➢ Vaccination,

		➢ SIR Endemic disease model, ➢ Evolution of Virulence
7-9	**Unit – 3**	➢ Haploid Genetics, ➢ Diploid Genetics, ➢ Frequency Dependent Selection, ➢ Linkage Equilibrium, ➢ Random Genetic Drift
10-12	**Unit – 4**	➢ Law of Mass Action, ➢ Enzyme Kinetics, ➢ Competitive Inhibition, ➢ Allosteric Inhibition, ➢ Cooperativity
13-15	**Unit – 5**	➢ DNA, ➢ Brute Force Alignment, ➢ Dynamic Programming, ➢ Gaps, ➢ Local Alignments, ➢ Software

		L	T	P	X	H	C
212MAT1302	**Vector Calculus**	3	1	0	0	4	4

Course Objective(s):

To enable the students to understand the concepts of Curvature, differentiation and integration in vector calculus, irrotational and solenoidal fields, line and surface integrals and application's to Green's theorem, Gauss Divergence theorem and Stoke's theorem.

Course Outcome(s):

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

CO1: understand the concepts of derivatives of vectors, del operator ∇, the hodograph, integration with applications to kinematics.

CO2: learn about divergence and curl of vector field, Taylor's theorem for vector function, applications to hydromechanics

CO3: solve problems using Green's theorem, Gauss theorem and Stoke's theorem and learn about "pot"

CO4: learn about " new, " " lap , " " ma x " and other important operators and relation between them

CO5: solve the problems on application of vector calculus.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	L	L	L	L	L	L	L	L	L
CO2	S	M	M	M	M	L	L	L	L	L	L	L

CO3	S	M	S	M	M	M	L	L	L	L	L	L
CO4	S	S	S	M	M	L	L	L	L	L	L	L
CO5	S	S	S	M	M	L	L	L	L	L	L	L

S- Strong; M-Medium; L– Low.

UNIT-I: Differential Calculus of Vectors	**(18 Hours)**
derivatives and differentials of vector functions with respect to a scalar variable, curvature and torsion of gauche curves, kinematics of a particle, the hodograph, the instantaneous axis of rotation, integration with applications to kinematics, scalar functions of position in space, the vector differentiating operator, ∇ the scalar operator, A.∇	
UNIT-II: More on Differential Calculus of Vectors	**(18 Hours)**
vector functions of position in space, divergence ∇. And the curl ∇×, interpretation of the divergence ∇. interpretation of the curl ∇×, laws of operation of ∇, ∇. , ∇× , the partial application of ∇. expansion of a vector function analogous to taylor's theorem. Applications to hydromechanics the differentiating operators of the second order, geometric interpretation of laplace's operator ∇ as the dispersion	
UNIT-III: Integral Calculus of Vectors	**(18 Hours)**
line integrals of vector functions with applications, gauss's theorem, stokes theorem, converse of stokes's theorem with applications, transformations of line , surface, and volume integrals, Green's theorem, remarks on multiple-valued functions, potential. the integrating operator "pot" , commutative property of pot and ∇, remarks upon the foregoing	
UNIT-IV: More on Integral Calculus of Vectors	**(18 Hours)**
the integrating operators "new," " lap , " " ma x, relations between the integrating and differentiating operators, the potential "pot " is a solution of Poisson ' s equation, solenoidal and irrotational parts of ' a vector function . certain operators and their inverse, mutual potentials , Newtonians , Laplacians , and Maxwellians, certain boundary value theorems	
UNIT-V: Applications of Vector Calculus	**(18 Hours)**
quadric surfaces, the propagation of light in crystals, variable dyadics, curvature of surfaces harmonic vibrations and bivectors.	
TEXT BOOK(S)	
1. Edwin B Idwel L Wilso N, Vector Analysis, New York: Charles Scribner 'S Sons London : Edward Arnold 1 9 0 1, Unit I: Chapter 3, Arts 55 to 68; Unit II: Chapter 3, Arts 69 to 78; Unit III: Chapter 4, Arts 79 to 89; Unit IV: Chapter 4, Arts 90 to 96; Unit V: Chapter 7, Arts 136 to 162;	
REFERENCE BOOKS 1.Murray R Spiegel, Vector Analysis and an Introduction to Tensor Analysis, SCHAUM's Series, McGraw Hill, 1959	

VECTOR CALCULUS – 212MAT1302

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ derivatives and differentials of vector functions with respect to a scalar variable
2		➢ curvature and torsion of gauche curves, kinematics of a particle, the hodograph, the instantaneous axis of rotation,
3		➢ integration with applications to kinematics, scalar functions of position in space, the vector differentiating operator, ∇ the scalar operator, A.∇
4	**Unit – 2**	➢ vector functions of position in space, divergence ∇. And the curl ∇×,
5		➢ interpretation of divergence ∇. interpretation of the curl ∇×, laws of operation of ∇, ∇. , ∇× „
6		➢ the partial application of ∇. expansion of a vector function analogous to taylor's theorem. Applications to hydromechanics„ the differentiating operators of the second order, geometric interpretation of laplace's operator ∇ as the dispersion
7	**Unit – 3**	➢ line integrals of vector functions with applications, gauss's theorem, stokes theorem
8		➢ converse of stokes's theorem with applications, transformations of line , surface, and volume integrals
9		➢ Green's theorem, remarks on multiple-valued functions, potential. the integrating operator "pot", commutative property of pot and ∇, remarks upon the foregoing
10	**Unit – 4**	➢ the integrating operators "new," "lap , " " ma x, ➢ relations between the integrating and differentiating operators, ➢ the potential "pot " is a solution of Poisson ' s equation
11		➢ solenoidal and irrotational parts of 'a vector function. ➢ certain operators and their inverse,
12		➢ mutual potentials, Newtonians, Laplacians, and Maxwellians, certain boundary value theorems
13	**Unit – 5**	➢ quadric surfaces, the propagation of light in crystals
14		➢ variable dyadic, curvature of surfaces
15		➢ harmonic vibrations and bivectors.

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212MAT2107	**Discrete Mathematics**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective:

To enable the students to acquire the basic knowledge in propositional calculus, predicate calculus, counting techniques and Boolean algebra.

Course Outcome(s):

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

CO1 construct simple mathematical proof and possess the ability to verify them
CO2 apply basic counting techniques to solve combinatorial problems
CO3 understand the concepts of recurrence relations, generating functions, inclusion and exclusion principles.
CO4 apply the concepts of Boolean functions in switching theory
CO5 construct simple mathematical proof and possess the ability to verify them.

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M		S								S
CO2	S	S	S	S								L
CO3	S		M	S								L
CO4	S			S								L
CO5	S	L		S								M

*S – Strong; M – Medium; L – Low

UNIT-I: Propositional Calculus	**(12 Hours)**
Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy. .	
UNIT-II: Counting	**(12 Hours)**
The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Generating Permutations and Combinations.	
UNIT-III: Advanced Counting Techniques	**(12 Hours)**
Applications of Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion–Exclusion, Applications of Inclusion–Exclusion	
UNIT-IV: Boolean Algebra	**(12 Hours)**
Boolean Functions, Representing Boolean Functions, Logic Gates ., Minimization of Circuits	
UNIT-V: Predicate Calculus	**(12 Hours)**

Syntax of Predicate Logic, Free and Bound Variables, Semantics of Predicate Logic, A simpler notation, Tableaus, Soundness, Completeness, Full Predicate Logic, Semantics, Tableaus, Soundness, Completeness, Peano Arithmetic.
TEXT BOOK(S)
1.Kenneth H. Rosen, Discrete Mathematics and Its Applications, Published by McGraw-Hill, 1981 Unit I: Chapter 1; Unit II: Chapter 6; Unit III: Chapter 8; Unit IV: Chapter 12; 2. J. Keisler, K. Kunen, T. Millar, A. Miller, J. Robbin, Mathematical Logic and Computability, https://people.math.wisc.edu/~miller/res/book.pdf Feb 2006. Unit V: Chapter 2 to 3
REFERENCE BOOK(S) **1.** J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science, TMG Edition, Tata-Mcgraw Hill Publishing Company, 2001 **2.** Norman L. Biggs, Discrete Mathematics, Oxford Publications, Tenth Impression 2010. **3.** Alan Doerr and Kenneth Levasseur, Applied Discrete Structures for Computer science, Asian Student Edition, Compueter Science Series, 1999, Galgotia Publications Pvt Ltd. **4.** L.Lovasz, J.Pelikan, K.Vesztergombi, Discrete Mathematics, Elementary and Beyond, Springer International Edition, 2001

Discrete Mathematics – 212MAT2107

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Propositional Logic , ➢ Applications of Propositional Logic,
2		➢ Propositional Equivalences, Predicates and Quantifiers ,
3		➢ Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy
4	**Unit – 2**	➢ The Basics of Counting, ➢ The Pigeonhole Principle, ➢ Permutations and Combinations
5		➢ Binomial Coefficients and Identities, ➢ Generalized Permutations and Combinations, ➢ Generating Permutations and Combinations .
6		➢ Monotone and Inverse Functions
7	**Unit – 3**	➢ Applications of Recurrence Relations, ➢ Solving Linear Recurrence Relations
8		➢ Divide-and-Conquer Algorithms and Recurrence Relations ➢ Generating Functions
9		➢ Inclusion–Exclusion, ➢ Applications of Inclusion–Exclusion
10	**Unit – 4**	➢ Boolean Functions, ➢ Representing Boolean Functions, ➢

11		➢ Logic Gates
12		➢ Minimization of Circuits
13	**Unit – 5**	➢ Languages and Grammars, ➢ Finite-State Machines with Output, ,
14		➢ Finite-State Machines with No Output
15		➢ Language Recognition, Turing Machines

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212MAT2108	**Real Analysis**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective:

To enable the students to acquire the essential knowledge on Real Numbers, Limits and Continuity, Derivatives and Integrals, Sequence and Series, Lebesgue Integrals.

Course Outcome(s).

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

CO1 describe the fundamental properties of the real numbers that underpin the formal development of real analysis.

CO2 demonstrate the concept of limits, continuity, uniform continuity, monotone and inverse functions.

CO3 implement the concepts of Mean Value theorem, Taylor's theorem, integral and Darboux integral.

CO4 discuss the concepts of of convergence and divergence for the given sequence and series.

CO5 establish the concepts of open sets and closed sets of metric spaces to compact sets.

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										L
CO2	S	S										L
CO3	S	S		M								L
CO4	S	S		M								L
CO5	M	L										L

*S – Strong; M – Medium; L – Low

UNIT-I:Real Numbers	**(12 Hours)**

Real Numbers: The Algebraic and Order Properties of R, Absolute Value and the Real Line, The Completeness Property of R, Applications of the Supremum Property, Intervals, SEQUENCES AND SERIES, Sequences and Their Limits, Limit Theorems, Monotone Sequences, Subsequences and the Bolzano-Weierstrass Theorem, The Cauchy Criterion, Properly Divergent Sequences, Introduction to Infinite Series	
UNIT-II: Concept of Limit and Functions	**(12 Hours)**
Limits of Functions, Limit Theorems, Some Extensions of the Limit Concept, Continuous Functions, Combinations of Continuous Functions, Continuous Functions on Intervals, Uniform Continuity, Continuity and Gauges , Monotone and Inverse Functions	
UNIT-III: Concept of Derivative and Integrals	**(12 Hours)**
The Derivative, The Mean Value Theorem, L'Hospital's Rules, Taylor's Theorem, Riemann Integral, Riemann Integrable Functions, The Fundamental Theorem, The Darboux Integral, Approximate Integration	
UNIT-IV: Sequences and Series of Functions	**(12 Hours)**
SEQUENCES OF FUNCTIONS, Pointwise and Uniform Convergence, Interchange of Limits, The Exponential and Logarithmic Functions, The Trigonometric Functions, INFINITE SERIES, Absolute Convergence, Tests for Absolute Convergence, Tests for Non-absolute Convergence, Series of Functions	
UNIT-V: Beyond Riemann Integrals	**(12 Hours)**
THE GENERALIZED RIEMANN INTEGRAL, Definition and Main Properties, Improper and Lebesgue Integrals, Infinite Intervals, Convergence Theorems, A GLIMPSE INTO TOPOLOGY, Open and Closed Sets in R, Compact Sets, Continuous Functions, Metric Spaces	
TEXT BOOK(S)	
Robert G. Bartle Donald R. Sherbert, INTRODUCTION TO REAL ANALYSIS, Fourth Edition, John Wiley & Sons, Inc. 2011. Unit I: Chapter 2: Unit II: Chapters 4, 5; Unit III: Chapters 6, 7; Unit IV: Chapters 8, 9; Unit V: Chapter 10, 11	
REFERENCE BOOK(S) 1. R. Goldberg, *Methods of Real Analysis*, *John Wiley and Sons,* 1976. 2. Rudin, *Principles of Mathematical Analysis*. McGraw-Hill1976. 3. L. Cohen and Ehrlick, *Structure of the Real Number System.* New York, D. Van Nostrand Reinhold, 1963 4. T. Apostol, *Calculus, vols I and II, John Wiley and Sons, 1967/1969*	

REAL ANALYSIS – 212MAT2108

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ The Algebraic and Order Properties of R, Absolute Value and the Real Line, The Completeness Property of R ➢ Applications of the Supremum Property, Intervals

2		➢ Sequences and Their Limits, Limit Theorems, ➢ Monotone Sequences, Subsequences and the Bolzano-Weierstrass Theorem
3		➢ The Cauchy Criterion, Properly Divergent Sequences, ➢ Introduction to Infinite Series
4	**Unit – 2**	➢ Limits of Functions, Limit Theorems, Some Extensions of the Limit Concept ➢ Continuous Functions, Combinations of Continuous Functions
5		➢ Continuous Functions on Intervals, Uniform Continuity ➢ Continuity and Gauges
6		➢ Monotone and Inverse Functions
7	**Unit – 3**	➢ The Derivative, The Mean Value Theorem, ➢ L'Hospital's Rules ➢ Taylor's Theorem
8		➢ Riemann Integral ➢ Riemann Integrable Functions ➢ The Fundamental Theorem,
9		➢ The Darboux Integral ➢ Approximate Integration
10	**Unit – 4**	➢ Pointwise and Uniform Convergence ➢ Interchange of Limits, The Exponential and Logarithmic Functions, ➢ The Trigonometric Functions
11		➢ INFINITE SERIES, Absolute Convergence,
12		➢ Tests for Absolute Convergence ➢ Tests for Non-absolute Convergence, Series of Functions
13	**Unit – 5**	➢ THE GENERALIZED RIEMANN INTEGRAL , Definition and Main Properties ➢ Improper and Lebesgue Integrals
14		➢ Infinite Intervals, Convergence Theorems,
15		➢ A GLIMPSE INTO TOPOLOGY, Open and Closed Sets in R, Compact Sets, Continuous Functions, Metric Spaces

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212MAT1109	**Linear Algebra**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective(s):

To enable the students to understand the concepts of vector spaces, determinants, matrices, linear transformations and an elementary introduction to canonical forms.

Course Outcome(s):

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

CO1: understand the concepts of vector spaces, bases, dimensions and computation of vector subspaces.

CO2: relate matrices and linear transformations, linear functionals, double dual.

CO3: know about the algebra of polynomials.
CO4: understand the concept of rings and determinant functions, modules.
CO5: learn the elementary canonical forms and applications to diagonalization method.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	L										
CO2	S	M										
CO3	S	M	S									
CO4	S											
CO5	S		S									

S- Strong; M-Medium; L– Low

UNIT -I: Vector Spaces	**(12 Hours)**
Vector Spaces, Subspaces Bases and Dimension, Summary of Row-Equivalence. Computations Concerning Subspaces	
UNIT-II: Linear Transformations	**(12 Hours)**
Linear Transformations, The Algebra of Linear Transformations, Isomorphism, Representation of Transformations by Matrices, Linear Functionals, The Double Dual, The Transpose of a Linear Transformation	
UNIT-III: Polynomials	**(12 Hours)**
Algebras, The Algebra of Polynomials, Lagrange Interpolation, Polynomial Ideals, The Prime Factorization of a Polynomial	
UNIT-IV: Determinants	**(12 Hours)**
Commutative Rings, Determinant Functions, Permutations and the Uniqueness of Determinants Additional Properties of Determinants, Modules, Multilinear Functions, The Grassman Ring	
UNIT-V: Elementary Canonical Forms	**(12 Hours)**
Introduction, Characteristic Values, Annihilating Polynomials, Invariant Subspaces, Simultaneous Triangulation; Simultaneous Diagonalization, Direct-Sum Decompositions,, Invariant Direct Sums The Primary Decomposition Theorem	
TEXT BOOK(S)	
1. KENNETH HOFFMAN And RAY KUNZE, LINEAR ALGEBRA Second Edition, PRENTICE-HALL, INC, 1971. Unit I: Chapter 2 Unit II: Chapter 3; Unit III: Chapter 4; Unit IV: Chapter 5 ; Unit V: Chapter 6	

REFERENCE BOOK(S)

1.Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Kindle 2021.

Linear Algebra – 212MAT1109

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Vector Spaces, Subspaces Bases and Dimension,
2		➢ Summary of Row-Equivalence.
3		➢ Computations Concerning Subspaces:
4	**Unit – 2**	➢ Linear Transformations, The Algebra of Linear Transformations
5		➢ Isomorphism, Representation of Transformations by Matrices,
6		➢ Linear Functionals, The Double Dual, The Transpose of a Linear Transformation
7	**Unit – 3**	➢ Algebras, The Algebra of Polynomials,
8		➢ Lagrange Interpolation, Polynomial Ideals,
9		➢ The Prime Factorization of a Polynomial
10	**Unit – 4**	➢ Commutative Rings, Determinant Functions
11		➢ Permutations and the Uniqueness of Determinants
12		➢ Additional Properties of Determinants, Modules, Multilinear Functions, The Grassman Ring
13	**Unit – 5**	➢ Introduction, Characteristic Values, Annihilating Polynomials
14		➢ Invariant Subspaces, Simultaneous Triangulation; Simultaneous Diagonalization,
15		➢ Direct-Sum Decompositions,, Invariant Direct Sums The Primary Decomposition Theorem

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212MAT1110	**Differential Geometry**	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

The objective of this course is to make the students understand the general theory of curves and surfaces. Students will start being able to develop arguments in the geometric description of curves and surfaces in order to establish basic properties of geodesics, parallel translation and surfaces of constant mean curvature.

COURSE OUTCOMES

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

CO1 understand the fundamental concept on space curves and surfaces,

CO2 compute quantities of geometric interest such as curvature

CO3 learn the method of the moving frame and overdetermined systems of differential equations as they arise in surface theory

CO4 interpret Holonomy and Hyperbolic Geometry

CO5 know about the Calculus of Variations and Surfaces of Constant Mean Curvature

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S	S										
CO3	S	M										
CO4	S											
CO5	S	M										

*S – Strong; M – Medium; L – Low

UNIT-I: Curves	**(12 Hours)**
Examples, Arc length Parametrization, Local Theory: Frenet Frame, Some Global Results	
UNIT-II: Parametrized Surfaces	**(12 Hours)**
Parametrized Surfaces and the First Fundamental Form, The Gauss Map and the Second Fundamental Form	
UNIT-III: More on Surface Theory	**(12 Hours)**
The Codazzi and Gauss Equations and the Fundamental Theorem of Surface Theory, Covariant Differentiation, Parallel Translation, and Geodesics	

UNIT-IV: Holonomy	**(12 Hours)**
Holonomy and the Gauss-Bonnet Theorem, An Introduction to Hyperbolic Geometry	
UNIT-V: Differential Forms	**(12 Hours)**
Surface Theory with Differential Forms, Calculus of Variations and Surfaces of Constant Mean Curvature	
TEXT BOOK(S)	
1. Theodore Shifrin, Differential Geometry:A First Course in Curves and Surfaces, copyright, 2016 Theodore Shifrin Unit I: Chapter 1 Unit II: Chapter 2 Sections 1, 2; Unit III: Chapter 2 Sections 3,4; Unit IV: Chapter 3 Sections 1, 2; Unit V: Chapter 3, Sections 3, 4	
REFERENCE BOOK(S) 1. Shoshichi Kobayashi, Differential Geometry of Curves and Surfaces. Springer, 2010 2. Szechenyi TERV, Differential Geometry, © 2014–2019, Bal´azs Csik´os, 2019.	

Differential Geometry – 212MAT1110

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Examples, Arc length Parametrization, :
2		➢ Local Theory
3		➢ Frenet Frame, Some Global Results
4	**Unit – 2**	➢ Parametrized Surfaces,
5		➢ First Fundamental Form
6		➢ The Gauss Map and the Second Fundamental Form
7	**Unit – 3**	➢ Continuous Mappings, Intermediate Value Theorem
8		➢ The Codazzi and Gauss Equations and the Fundamental Theorem of Surface Theory,
9		➢ Fundamental Theorem of Surface Theory
10	**Unit – 4**	➢ Product Topology, Projections onto Factors of a Product
11		➢ Tychonoff's Theorem for Finite Products
12		➢ Covariant Differentiation, Parallel Translation, and Geodesics
13	**Unit – 5**	➢ Surface Theory with Differential Forms
14		➢ Calculus of Variations and Surfaces of Constant
15		➢ Mean Curvature

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212MAT1303	**Introduction to Special Functions**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective(s):

Acquire knowledge about the function that describes the situation in which one quantity determines another quantity, and solve problems in mathematical analysis, functional analysis, geometry, physics, or other applications.

COURSE OUTCOMES

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

CO1 understand the basic ideas of special functions

CO2 study hypergeometric functions, the properties and types of hypergeometric functions

CO3 study in detail the technology and applications of Legendre functions

CO4 understand the concept of Bessel functions

CO5 understand the concepts of Hermite and Laguerre functions

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S										
CO2	L		M									L
CO3		S									M	
CO4	**S**											L
CO5		M										

*S – Strong; M – Medium; L – Low

UNIT-I: Basics of Special Functions	**(12 Hours)**
Origin of Special Functions, ordinary points of a linear differential equation, Regular singular points, point at infinity, gamma function and related functions, examples	
UNIT-II: Hypergeometric Functions	**(12 Hours)**
Hypergeometric series, Inegral formula, hypergeometric equations, linear relations b/w olutions of hypergeometric equations, relations of contiguity, confluent hypergeometric function, generalized hypergeometric series, examples	

UNIT-III: Legendre Functions	**(12 Hours)**
Legendre Polynomials, Recurrence relations, Formula of Murphy and Rodrigues, series of Legendre polynomials, Legendre's Differential equations, Neumann's formula, Recurrence relations for the function $Q_n(\mu)$, Use in Potential Theory, associated functions and their integral expressions, surface spherical harmonics, Use in wave mechanics	
UNIT-IV: Bessel Functions	**(12 Hours)**
Origin, Recurrence relations for Bessel coefficients, Integral expressions, Addition formula, Bessel's Differential equations, Spherical Bessel functions, Integrals involving Bessel functions, modified Bessel functions, Ber and Bei functions, Expansions in series of Bessel functions, Use in potential theory, Asymptotic expansions, Examples	
UNIT-V: Hermite and Laguerre Functions	**(12 Hours)**
Hemrmite polynomials, Hermite Differential equations, Hermite functions, Occurrence in wave mechanics, Laguerre polynomials, Laguerre Differential equations, Associated polynomials and functions, Wave functions for the hydrogen atom, Examples	
TEXT BOOK(S)	
1.Ian N Sneedon, Special Functions of Mathematical Physics and Chemistry, Oliver and Boyd, 1966. Unit I: Chapter 1; Unit II: Chapter 2; Unit III: Chapter 3; Unit IV: Chapter 4; Unit V: Chapter 5	
REFERENCE BOOK(S) 1. G. E. Andrews, R. Askey, Ranjan Roy, Special Functions, Encyclopedia of Mathematics and its Applications, Cambridge University Press, 1999. 2. E. D. Rainville, Special Functions, Macmillan, New York, 1960	

Introduction to Special Functions –212MAT1303

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Origin of Special Functions, ordinary points of a linear differential equation
2		➢ Regular singular points, point at infinity,
3		➢ gamma function and related functions, examples
4	**Unit – 2**	➢ Hypergeometric series, Integral formula, hypergeometric equations
5		➢ linear relations b/w solutions of hypergeometric equations, relations of contiguity
6		➢ confluent hypergeometric function, generalized hypergeometric series, examples
7	**Unit – 3**	➢ Legendre Polynomials, Recurrence relations, Formula of Murphy and Rodrigues, series of Legendre polynomials,
8		➢ Legendre's Differential equations, Neumann's formula, Recurrence relations for the function $Q_n(\mu)$
9		➢ Use in Potential Theory, Associated functions and their integral expressions, surface spherical harmonics, Use in wave mechanics

10	**Unit – 4**	➢ Origin, Recurrence relations for Bessel coefficients, Integral expressions, Addition formula, Bessel's Differential equations, Spherical Bessel functions
11		➢ Integrals involving Bessel functions, modified Bessel functions, Ber and Bei functions
12		➢ Expansions in series of Bessel functions, Use in potential theory, Asymptotic expansions, Examples
13	**Unit – 5**	➢ Hermite polynomials, Hermite Differential equations, Hermite functions
14		➢ Occurrence in wave mechanics, Laguerre polynomials, Laguerre Differential equations
15		➢ Associated polynomials and functions, Wave functions for the hydrogen atom, Examples

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212MAT2111	**Complex Analysis**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective(s):

To enable the students to understand the basic concept of complex variables.

Course Outcome(s):

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

CO1: analyze analytic functions and continuous functions.

CO2: understand local properties of analytic functions.

CO3:.apply Cauchy's theorem for disk and the Integral formula.

CO4: differentiate the Taylor's series and Laurent series.

CO5: study Residue theorem and the argument principle.

CO – PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**S**	**S**		M								**L**
CO2	**S**	**S**										**L**
CO3	**L**	**L**		**M**								**L**
CO4	**L**	**M**		**M**								**L**

CO5	M	L										L

*S – Strong; M – Medium; L – Low

UNIT-I:Complex Numbers	(18 Hours)
Complex Numbers: Arithmetic Operations, Square Roots, Justification, Conjugation, Absolute Value, Inequalities, Geometric Addition and Multiplication, Binomial Equation, Analytic Geometry, Spherical Representation	
UNIT-II: Analytic Functions	**(18 Hours)**
Concept of Analytic Function, Polynomials, Rational Functions, Sequences, Series, Uniform Convergence, Power Series, Abel's Limit Theorem, Exponential, Trigonometric Functions, Periodicity Logarithm.	
UNIT-III: Conformal Mappings and Riemann Surfaces	**(18 Hours)**
Arcs and Closed Curves, Analytic Functions in Regions, Conformal Mapping, Length and Area, The Linear Group, The Cross Ratio, Symmetry, Oriented Circles, Families of Circles, The Use of Level Curves, A Survey of Elementary Mappings, Elementary Riemann Surfaces	
UNIT-IV: Complex Integration	**(18 Hours)**
Line Integrals, Rectifiable Arcs, Line Integrals as Functions of Arcs, Cauchy's Theorem for a Rectangle, Cauchy's Theorem in a Disk, The Index of a Point with Respect to a Closed Curve, The Integral Formula, Higher Derivatives, Removable Singularities. Taylor's Theorem, Zeros and Poles, The Local Mapping, The Maximum Principle	
UNIT-V: Chains, Cycles and Homology	**(18 Hours)**
Chains and Cycles, Simple Connectivity, Homology, The General Statement of Cauchy's Theorem 4.5 Proof of Cauchy's Theorem 4.6 Locally, Exact Differentials, Multiply Connected Regions, The Residue Theorem 5., The Argument Principle, Evaluation of Definite Integral, Definition and Basic Properties, The Mean-value Property, Poisson's Formula, Schwarz's Theorem, The Reflection Principles	
TEXT BOOK(S)	
Lars V. Ahlfors, Complex Anlysis, McGraw-Hill Inc, 1979. Unit-I: Chapter 1; Unit-II: Chapter 2; Unit-III: Chapter 3, Subivisions 2, 3 and 4; Unit-IV: Chapter 4, Subdivisons 1, 2 and 3 ; Unit-V: Chapter 4, Subdivisions 4, 5 and 6	
REFERENCE BOOKS Bak, Joseph, Newman Donald, J, Complex Analysis, Springer, 2010**,**	

COMPLEX ANALYSIS – 212MAT2111

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Complex Numbers: Arithmetic Operations, Square Roots, Justification
2		➢ Absolute Value, Inequalities, Geometric Addition and Multiplication
3		➢ Geometric Addition and Multiplication, Binomial Equation, Analytic Geometry, Spherical Representation
4	**Unit – 2**	➢ Concept of Analytic Function, Polynomials, Rational Functions

5		➢ Sequences, Series, Uniform Convergence, Power Series,
6		➢ Abel's Limit Theorem, Exponential, Trignometric Functions, Periodicity, Logarthm,
7	**Unit – 3**	➢ Arcs and Closed Curves, Analytic Functions in Regions
8		➢ Conformal Mapping, Length and Area, The Linear Group, The Cross Ratio, Symmetry, Oriented Circles,
9		➢ Families of Circles, The Use of Level Curves, A Survey of Elementary Mappings, Elementary Riemann Surfaces
10	**Unit – 4**	➢ Line Integrals, Rectifiable Arcs, Line Integrals as Functions of Arcs ➢ Cauchy's Theorem for a Rectangle, Cauchy's Theorem in a Disk, The Index of a Point with Respect to a Closed Curve ➢ The Integral Formula, Higher Derivatives, Removable Singularities.,
11		➢ Taylor's Theorem, ➢ Zeros and Poles ➢ The Local Mapping
12		➢ The Maximum Principle
13	**Unit – 5**	➢ Chains and Cycles, Simple Connectivity, Homology, The General Statement of Cauchy's Theorem 4.5
14		➢ Proof of Cauchy's Theorem 4.6 Locally, Exact Differentials, Multiply Connected Regions
15		➢ The Residue Theorem 5., The Argument Principle, Evaluation of Definite Integral, Definition and Basic Properties The Mean-value Property, Poisson's Formula, Schwarz's Theorem, The Reflection Principles

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212MAT1112	**Number Theory**	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

To squeeze out meritoriously the concepts and results of Number Theory and to apply at various real-life conjectures, by understanding the logics and methods behind.

COURSE OUTCOMES

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

CO1 prove results involving divisibility and greatest common divisors

CO2 apply Euler-Fermat's Theorem to prove relations involving prime numbers.

CO3 identify Perfect, Fermat and Amicable numbers to apply in various fields.

CO4	define and analyse Congruency, Divisibility criteria, Euler's phi-function, and Conditional linear congruences.
CO5	solve systems of linear, Polynomial, Quadratic congruences and find Primitive roots

CO - PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										L
CO2	S	M	S									L
CO3	S	L	M									L
CO4	S											
CO5	S	L										

*S – Strong; M – Medium; L – Low

UNIT-I: Divisibility	**(18 Hours)**
The division algorithm, The greatest common divisor, The Euclidean algorithm, Pythagorean triples	
UNIT-II: Prime numbers	**(18 Hours)**
Euclid on primes, Number theoretic functions, Multiplicative functions, Factoring, The greatest integer function, Primes revisited	
UNIT-III: Perfect and amicable numbers	**(18 Hours)**
Perfect numbers, Fermat numbers, Amicable numbers, Perfect-type numbers	
UNIT-IV: Modular arithmetic	**(18 Hours)**
Congruence, Divisibility criteria, Euler's phi-function, Conditional linear congruences	
UNIT-V: Congruences of higher degree	**(18 Hours)**
Polynomial congruences, Quadratic congruences, Primitive roots	
TEXT BOOK(S)	
1 JAMES J. TATTERSALL, Elementary number theory in nine chapters, Cambridge University Press, 1999. Unit-I: Chapters 2; Unit-II: Chapters 3; Unit-III: Chapters 4; Unit-IV: Chapters 5 ; Unit-V: Chapters 6	
REFERENCE BOOKS **1.** David Pierce, Elementary Number Theory, copy right, David Austin Pierce, Sep 20, 2012	

Number Theory – 212MAT1112

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ The division algorithm, The greatest common divisor, The Euclidean algorithm, Pythagorean triples
4	**Unit – 2**	➢ Euclid on primes, Number theoretic functions, Multiplicative functions, Factoring, the greatest integer function, Primes revisited
7	**Unit – 3**	➢ Perfect numbers, Fermat numbers, Amicable numbers, Perfect-type numbers
10	**Unit – 4**	➢ Congruence, Divisibility criteria, Euler's phi-function, Conditional linear congruences
13	**Unit – 5**	➢ Polynomial congruences, Quadratic congruences, Primitive roots

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212MAT1113	**Probability and Distribution Theory**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective:

Emphasis is placed on theoretical understanding on statistical probabilistic models and the applications of various distributions. The course enables the students to acquire the fundamental ideas about randomness and the use of sampling techniques in real life scenarios.

Course Outcome(s):

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

CO1 describes the concept of probability, expectation and some ideas on inequalities.
CO2 incorporates the conditional probabilities and highlights the correlation techniques.
CO3 exemplifies the knowledge in some statistical distributions.
CO4 gives the sampling approaches and derivatives for distribution functions of random variables.
CO5 demonstrates the concept of limiting distributions and applications of the central limit theorem.

CO – PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M						

CO2	**S**		**S**	**S**							**L**	
CO3	**S**											**L**
CO4	**S**											
CO5	**S**	**S**	**S**	**S**								

*S – Strong; M – Medium; L – Low

UNIT-I: Distributions of Random Variables	**(18 Hours)**
Introduction, Algebra of Sets, Set Functions, The Probability Set Function, Random Variables, The Probability Density Function, The Distribution Function, Certain Probability Models, Mathematical Expectation, Some Special Mathematical Expectations, Chebyshev's Inequality	
UNIT-II: Conditional Probability and Stochastic Independence	**(18 Hours)**
Conditional Probability, Marginal and Conditional Distributions, The Correlation Coefficient Stochastic Independence	
UNIT-III: Some Special Distributions	**(18 Hours)**
The Binomial, Trinomial, and Multinomial Distributions, The Poisson Distribution, The Gamma and Chi-Square Distributions, The Normal Distribution, The Bivariate Normal Distribution	
UNIT-IV: Distributions of Functions of Random 'Variables	**(18 Hours)**
Sampling Theory, Transformations of Variables of the Discrete Type, Transformations of Variables of the Continuous Type, The t and F Distributions, Extensions of the Change-of-Variable Technique, Distributions of Order Statistics, The Moment-Generating-Function Technique, The Distributions of $E(X)$ and nS^2/σ^2 Expectations of Functions of Random Variables	
UNIT-V: Limiting Distributions	**(18 Hours)**
Limiting Distributions, Stochastic Convergence, Limiting Moment-Generating Functions, The Central Limit Theorem, Some Theorems on Limiting Distributions	
TEXT BOOK(S)	
1 Robert V. Hogg Allen T. Craig, Introduction to Mathematical Statistics Fourth Edition, Macmillan Publishing Co., Inc., 1978 Unit-I: Chapters 1; Unit-II: Chapters 2; Unit-III: Chapters 3; Unit-IV: Chapters 4 ; Unit-V: Chapters 5	
REFERENCE BOOKS **2.** Davison, A.C., Statistical models. Cambridge University Press. 2003 **3.** Freedman, D., Statistical models: theory and applications. Cambridge University Press,2005 **4.** Lehmann, E.L. and Casella, G., Theory of point estimation. Springer. 1998. **5.** Lehmann, E.L. and Romano, J.P., Testing statistical hypotheses. Springer, 2005.	

Probability and Distribution Theory – 212MAT1113

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Introduction, Algebra of Sets, Set Functions, The Probability Set Function, Random Variables, The Probability Density Function, The Distribution Function, Certain Probability Models, Mathematical Expectation, Some Special Mathematical Expectations, Chebyshev's Inequality

4	**Unit – 2**	➢ Conditional Probability, Marginal and Conditional Distributions, The Correlation Coefficient, Stochastic Independence
7	**Unit – 3**	➢ The Binomial, Trinomial, and Multinomial Distributions, The Poisson Distribution, The Gamma and Chi-Square Distributions, The Normal Distribution, The Bivariate Normal Distribution
10	**Unit – 4**	➢ Sampling Theory, Transformations of Variables of the Discrete Type, Transformations of Variables of the Continuous Type, The t and F Distributions, Extensions of the Change-of-Variable Technique, Distributions of Order Statistics, The Moment-Generating-Function Technique, The Distributions of E(X) and nS^2/σ^2 Expectations of Functions of Random Variables
13	**Unit – 5**	➢ Limiting Distributions, Stochastic Convergence, Limiting Moment-Generating Functions, The Central Limit Theorem, Some Theorems on Limiting Distributions

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212MAT1114	**Graph Theory**	**L**	**T**	**P**	**X**	**H**	**C**
		3	1	0	0	4	4

Course objective:

To enable the students to understand the basic concepts of Graph theory such as Trees, Eulerian Graphs, Matching, Vertex colourings, Edge colourings and Planarity. Graph Theory is an integral part of Discrete Mathematics and has applications in diversified areas such as Electrical Engineering, Computer science and Linguistics.

Course Outcomes:

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

1. know the basic concepts of graph theory, types of graphs and graph algorithms.
2. acquire the knowledge of properties of trees and connectivity.
3. know about the colorings and its applications.
4. learn the concept of digraphs, tournaments and markov Chains.
5. develop the knowledge about matchings and its applications.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			S								S
CO2				M							S	
CO3		S									S	
CO4			S							S		
CO5	S			L								

S- Strong; M-Medium; L– Low.

UNIT-I: Basics of Graph Theory	**(18 Hours)**
What is a Graph? , Definition, Examples, Three puzzles, Connectivity, Eulerian graphs, Hamiltonian graphs, Some algorithms	
UNIT-II: Trees and Planarity	**(18 Hours)**
Properties of trees, Counting trees, More applications, Planar graphs, Euler's formula, Graphs on other surfaces, Dua graphs, Infinite graphs	
UNIT-III: Coloring of Graphs	**(18 Hours)**
Coloring vertices, Brooks' theorem, Coloring maps, Coloring edges , Chromatic polynomials	
UNIT-IV: Digraphs	**(18 Hours)**
Definitions, Eulerian digraphs and tournaments, Markov chains	
UNIT-V: Matching, marriage and Menger's theorem	**(18 Hours)**
Hall's 'marriage' theorem, Transversal theory, Applications of Hall's theorem, Menger's theorem, Netwok flows	
TEXT BOOK(S)	
.1 Robin J. Wilson, Introduction to Graph Theory, Longman, Fourth edition, 1996 Unit-I: Chapters 1 to 3; Unit-II: Chapters 4 to 5; Unit-III: Chapters 6; Unit-IV: Chapters 7 ; Unit-V: Chapters 8	
REFERENCE BOOKS **6.** J. A. Bondy and U. S. R. Murty, GRAPH THEORY WITH APPLICATIONS, NORfH-HOLLAND, 1976. **7.** Reinhard Diestel, Graph Theory, Springer Verlag,	

Graph Theory 212MAT1114

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ What is a Graph? , Definition, Examples, Three puzzles, Connectivity, Eulerian graphs, Hamiltonian graphs, Some algorithms,
4	**Unit – 2**	➢ Properties of trees, Counting trees, More applications, Planar graphs, Euler's formula, Graphs on other surfaces, Dual graphs, Infinite graphs

7	**Unit – 3**	➢ Coloring vertices, Brooks' theorem, Coloring maps, Coloring edges Chromatic polynomials
10	**Unit – 4**	➢ Definitions, Eulerian digraphs and tournaments, Markov chains
13	**Unit – 5**	➢ Hall's 'marriage' theorem, Transversal theory, Applications of Hall's theorem, Menger's theorem, Netwok flows

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213MAT2103	**Actuarial Mathematics**	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

To enable the students to understand the basic concepts of deterministic and stochastic model, lifetable, life insurance, annuity, mortality, life contracts, decrements. expenses and profits.

COURSE OUTCOMES

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

CO1 determine interest and discounts using deterministic and stochastic models

CO2 calculate various life insurance premiums using spreadsheets.

CO3 calculate discounts, interest, fractional period premium and reserves of insurance.

CO4 apply changes in formulas and projections in annuity tables.

CO5 determine the model from the forces of decrement.

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	S	M			L			L	S
CO2	M	S	M	S	M			L			L	S
CO3	S	M	M	S	M			L			L	S
CO4	M	S	M	S	M			L			L	S
CO5	S	M	M	S	M			L			L	M

*S – Strong; M – Medium; L - Low

UNIT-I: Basic Deterministic Model	**(18 Hours)**
Risk and Insurance, Deterministic Vs Stochastic Models, Finance and Investments, Adequacy and Equity, Reassessment, cash flows, analogy with currencies, discount functions, calculating discount functions, interest and discount rates, constant interest, values and actuarial equivalence, vector notation, regular pattern cash flows, Balances and reserves, Time shifting and splitting identity,	

change of discount function, internal rates of return, forward prices and term structure, spreadsheet calculations	
UNIT-II: Life table, annuities and life insurance	**(18 Hours)**
Definitions, probabilities, constructing the life tables from the value of q_x Life expectancy, choice o life tables, sample table, calculating annuity premiums, interest and survivorship discount function guaranteed payments, deferred annuities with annual premiums, practical considerations spreadsheet calculations, calculating life insurance premiums, types of life insurance, combined insurance and annuity benefits, general insurance-annual identity, single and annual premium notation, spreadsheet applications	
UNIT-III: Insurance, annuity reserves, fractional durations	**(18 Hours)**
Reserves, general pattern, recursion, annuity contract, Bases for reserves, Nonforfeiture values policies involving return of the reserves, premium difference and paid-up formulas, spreadsheet applications, cash flows discounted with interest only, life annuities paid mthly, immediate annuities approximation and computation, fractional period premiums and reserves, reserves at fractiona durations, standard notations and terminology	
UNIT-IV: Continuous payments and select Mortality	**(18 Hours)**
Continuous annuities, force of discount, constant interest case, continuous life annuities, force of mortality, insurance payable at moment of death, premiums and reserves, general insurance annuity identity in the continuous case, differential equation of reserves, examples of exact calculation, further approximations, standard actuarial notation and terminology, select and ultimate tables, changes in formulas, projections in annuity tables	
UNIT-V: Multiple Life Contracts, Decrement Theory, Expenses and Profits	**(18 Hours)**
Joint Life status, annuities and insurances, last survivor annuities and insurances, moment of death insurances, general two life annuity contract, insurance contract, contingent insurances, duration problems, applications to annuity credit risk, spreadsheet calculations, basic model of decrement theory, determining the model from the forces of decrement, analogy with joint life statuses, machine analogy, associated single decrement tables, effect on reserves, realistic reserves and balance calculations, profit measurement	
TEXT BOOK(S)	
.1. S. David Promislow, Fundamentals of Actuarial Mathematics Third Edition, Wiley, 2015 Unit-I: Chapters 1 to 3; Unit-II: Chapters 4 to 5; Unit-III: Chapters 6 to 7; Unit-IV: Chapters 8 to 9 ; Unit-V: Chapters 10 to 12	
REFERENCE BOOKS **1.** David C.M.Dickson, Mary R. Hardy, Howard R. Waters, Actuarial Mathematics For Life Contingent RiskS, Cambridge University Press, 2009.	

Actuarial Mathematics – 213MAT2103

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Risk and Insurance, Deterministic Vs Stochastic Models, Finance and Investments, Adequacy and Equity, Reassessment, cash flows, analogy with currencies,
2		➢ discount functions, calculating discount functions, interest and discount rates, constant interest, values and actuarial equivalence, vector notation, regular pattern cash flows,

3		➢ Balances and reserves, Time shifting and splitting identity, change of discount function, internal rates of return, forward prices and term structure, spreadsheet calculations
4	**Unit – 2**	➢ Definitions, probabilities, constructing the life tables from the value of q_x Life expectancy, choice of life tables, sample table, calculating annuity premiums, interest and survivorship discount function,
5		➢ guaranteed payments, deferred annuities with annual premiums, practical considerations, spreadsheet calculations, calculating life insurance premiums,
6		➢ types of life insurance, combined insurance and annuity benefits, general insurance-annual identity, single and annual premium notation, spreadsheet applications
7	**Unit – 3**	➢ Reserves, general pattern, recursion, annuity contract, Bases for reserves, Nonforfeiture values, policies involving return of the reserves, premium difference and paid-up formulas
8		➢ spreadsheet applications, cash flows discounted with interest only, life annuities paid mthly,
9		➢ immediate annuities, approximation and computation, fractional period premiums and reserves, reserves at fractional durations, standard notations and terminology
10	**Unit – 4**	➢ Continuous annuities, force of discount, constant interest case, continuous life annuities, force of mortality, insurance payable at moment of death, premiums and reserves, general insurance annuity identity in the continuous case,
11		differential equation of reserves, examples of exact calculation, further approximations, standard actuarial notation and terminology,
12		➢ select and ultimate tables, changes in formulas, projections in annuity tables Joint Life status, annuities and insurances
13	**Unit – 5**	➢ last survivor annuities and insurances, moment of death insurances, general two life annuity contract, insurance contract, contingent insurances, duration problems, applications to annuity credit risk
14		➢ spreadsheet calculations, basic model of decrement theory, determining the model from the forces of decrement, analogy with joint life statuses,
15		➢ machine analogy, associated single decrement tables, effect on reserves, realistic reserves and balance calculations, profit measurement

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213MAT2104	**Cryptography**	L	T	P	X	H	C
		3	1	0	0	4	4

Course Objective(s):

To enable the students to understand the concepts of coding and decoding.

Course Outcome(s):

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

CO1: know the methods of conventional encryption.
CO2: understand the concepts of Block Ciphers and the Data Encryption
CO3: know Number theory concepts used for advanced encryption
CO4: understand Advanced encryption standard
CO5: know the methods of public key cryptography

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										L
CO2	S	L	L									L
CO3	M	S		M								L
CO4	S	S	S	M								L
CO5	M	L										L

*S – Strong; M – Medium; L – Low

UNIT-I: Data Security and Stram Ciphers	**(18 Hours)**
Simple Symmetric Encryption: The Substitution Cipher, Cryptanalysis,. General Thoughts on Breaking Cryptosystems, Modular Arithmetic and Ciphers, Modular Arithmetic, Integer Rings, Shift Cipher (or Caesar Cipher), Affine Cipher, Discussion and Further Reading, Stream Ciphers, Stream Ciphers vs. Block Ciphers, Encryption and Decryption with Stream Ciphers Random Numbers and an Unbreakable Stream Cipher, Random Number Generators, The One-Time Pad Towards Practical Stream Ciphers, Shift Register-Based Stream Ciphers, Linear Feedback Shift Registers (LFSR) Known-Plaintext Attack Against Single LFSRs.	
UNIT-II: Encryption Standards	**(18 Hours)**
DES, Confusion and Diffusion, DES Algorithm , Internal Structure of DES,. Initial and Final Permutation, The f-Function, Key Schedule, Decryption, Security of DES, Exhaustive Key Search, Analytical Attacks, The Advanced Encryption Standard (AES) and the AES Finalist Ciphers, Triple DES (3DES) and DESX, Lightweight Cipher PRESENT, AES Algorithm, Galois Fields, Existence of Finite Fields, Prime Fields, Extension Fields GF(2m), Addition and Subtraction in GF(2m), Multiplication in GF(2m, Inversion in GF(2m), Internal Structure of AES, Byte Substitution Layer, Diffusion Layer, Key Addition Layer, Key Decryption	
UNIT-III: Block Ciphers	**(18 Hours)**
Encryption with Block Ciphers: Modes of Operation, Electronic Codebook Mode (ECB), Cipher Block Chaining Mode (CBC), Output Feedback Mode (OFB), Cipher Feedback Mode (CFB), Counter Mode (CTR), Galois Counter Mode (GCM), Exhaustive Key Search Revisited, Increasing the Security of Block Ciphers, Double Encryption and Meet-in-the-Middle Attack, Triple Encryption, Key Whitening	
UNIT-IV: Public-Key Cryptography and RSA	**(18 Hours)**
Symmetric vs. Asymmetric Cryptography, Practical Aspects of Public-Key Cryptography, Security Mechanisms, The Remaining Problem: Authenticity of Public Keys, Important Public-Key Algorithms, Key Lengths and Security Levels, Key Generation and Proof of Correctness, Encryption and Decryption: Fast Exponentiation, Speed-up Techniques for RSA, Fast Encryption with Short Public Exponents, Fast Decryption with the Chinese Remainder Theorem, Finding Large Primes, How Common Are Primes?, Primality Tests, RSA in Practice: Padding	
UNIT-V Cryptosystems	**(18 Hours)**
The Discrete Logarithm Problem, The Discrete Logarithm Problem in Prime Fields, The Generalized Discrete Logarithm Problem, Attacks Against the Discrete Logarithm Problem, Security of the Diffie–Hellman Key Exchange, The Elgamal Encryption Scheme, From Diffie–Hellman Key Exhange to Elgamal Encryption, The Elgamal Protocol, Computational Aspects, Security, How to Compute with Elliptic Curves Definition of Elliptic Curves, Group Operations on Elliptic Curves, Building a Discrete Logarithm Problem with Elliptic Curves, Diffie–Hellman Key Exchange with Elliptic Curves, Security	
TEXT BOOK(S)	
1. Christof Paar, Jan Pelzl, Understanding Cryptography, Springer 2010. Unit-I:Chapters 1 to 2; Unit-II: Chapters 3 to 4; Unit-III: Chapters 5; Unit-IV: Chapters 6, to 7 ; Unit-V: Chapters 8 to 9	
REFERENCE BOOKS **1.** A.J. Menezes, P. van Oorschot and S.A. Vanstone. The Handbook of Applied Cryptography. CRC Press, 1997.	

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Simple Symmetric Encryption: The Substitution Cipher, Cryptanalysis,. General Thoughts on Breaking Cryptosystems, Modular Arithmetic and Ciphers, Modular Arithmetic, Integer Rings, Shift Cipher (or Caesar Cipher),
2		➢ Affine Cipher, Discussion and Further Reading, Stream Ciphers, Stream Ciphers vs. Block Ciphers, Encryption and Decryption with

		Stream Ciphers Random Numbers and an Unbreakable Stream Cipher
3		➢ Random Number Generators, The One-Time Pad Towards Practical Stream Ciphers, Shift Register-Based Stream Ciphers, Linear Feedback Shift Registers (LFSR) Known-Plaintext Attack Against Single LFSRs.
4	**Unit – 2**	➢ DES, Confusion and Diffusion, DES Algorithm , Internal Structure of DES,. Initial and Final Permutation, The f-Function, Key Schedule, Decryption, Security of DES, Exhaustive Key Search, Analytical Attacks,
5		➢ The Advanced Encryption Standard (AES) and the AES Finalist Ciphers, Triple DES (3DES) and DESX, Lightweight Cipher PRESENT, AES Algorithm, Galois Fields, Existence of Finite Fields,
6		➢ Prime Fields, Extension Fields GF(2m), Addition and Subtraction in GF(2m), Multiplication in GF(2m, Inversion in GF(2m), Internal Structure of AES, Byte Substitution Layer, Diffusion Layer, Key Addition Layer, Key Decryption
7	**Unit – 3**	➢ Encryption with Block Ciphers: Modes of Operation, Electronic Codebook Mode (ECB), Cipher Block Chaining Mode (CBC), Output Feedback Mode (OFB),
8		➢ Cipher Feedback Mode (CFB), Counter Mode (CTR), Galois Counter Mode (GCM), Exhaustive Key Search Revisited
9		➢ Increasing the Security of Block Ciphers, Double Encryption and Meet-in-the-Middle Attack, Triple Encryption, Key Whitening
10	**Unit – 4**	➢ Symmetric vs. Asymmetric Cryptography, Practical Aspects of Public-Key Cryptography, Security Mechanisms, The Remaining Problem: Authenticity of Public Keys,
11		Important Public-Key Algorithms, Key Lengths and Security Levels, Key Generation and Proof of Correctness, Encryption and Decryption: Fast Exponentiation, Speed-up Techniques for RSA,
12		➢ Fast Encryption with Short Public Exponents, Fast Decryption with the Chinese Remainder Theorem, Finding Large Primes, How Common Are Primes?, Primality Tests, RSA in Practice: Padding
13	**Unit – 5**	➢ The Discrete Logarithm Problem, The Discrete Logarithm Problem in Prime Fields, The Generalized Discrete Logarithm Problem, Attacks Against the Discrete Logarithm Problem
14		➢ Security of the Diffie–Hellman Key Exchange, The Elgamal Encryption Scheme, From Diffie–Hellman Key Exhange to Elgamal Encryption, The Elgamal Protocol, Computational Aspects, Security
15		➢ How to Compute with Elliptic Curves Definition of Elliptic Curves, Group Operations on Elliptic Curves, Building a Discrete Logarithm Problem with Elliptic Curves, Diffie–Hellman Key Exchange with Elliptic Curves, Security

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213MAT2107	**Astronomy**	**L**	**T**	**P**	**X**	**H**	**C**
		3	1	0	0	4	4

Course objective:

To enable the students to understand the various astronomical cycles that affect the Earth and appearance of the sky and by developing some familiarity with various tools and methodologies used to enhance and broaden our knowledge of the Universe. Throughout the semester we will build a conceptual framework that will increase your appreciation and understanding of the nature, scope, and evolution of the Universe.

Course Outcomes:

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

CO1. learn the basic concepts of Spherical Trigonometry.
CO2. gain the knowledge of Celestial Sphere.
CO3. know about the Refraction and its applications.
CO4. learn the concept of Meridian Circle.
CO5. develop the knowledge about Planetary motions.

CO- PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S			S								S
CO2				M							S	
CO3		S									S	
CO4			S							S		
CO5	S	S		L						S		M

S- Strong; M-Medium; L– Low.

UNIT-I: Spherical Trignometry	**(18 Hours)**
Spherical Triangles, Length of Small circle arc, Terrestrial Latitude and Longitude, Fundamental Formula, Sine Formula, Formula C, Four parts Formula, Alternative Proofs of the formula A, B, C, Right angled, Quadrantal triangles, Polar Formula, Haversine Formula, Trignometrical ratios of small angles, Delambres and Napier's analogies, Examples	
UNIT-II: Celestial Sphere	**(18 Hours)**
Altitude and Azimuth, Declination and Hour angle, Diagram for the southern hemisphere, Circumpolar stars, geocentric celestial sphere, solution of the spherical triangle PZX, Right ascension and declination, earth's orbit, celestial latitude and longitude, sidereal time, Mean solar time, Hour angle of a heavenly body, rising and setting, rate of change of zenith distance and azimuth, Twilight	
UNIT-III: Refraction	**(18 Hours)**
Laws of refraction, refraction for small Zenith Distances, general formula for refraction, effect of refraction on the time of sunset, Effect of refraction on the right ascension and declination of star, Examples,	
UNIT-IV: Meridian Circle	**(18 Hours)**

General Description and instrumental errors, Azimuth error and level error and their determinations, collimation error, total correction to the observed time of transit, Bessel's formula, wire intervals, chronograph, measurement of declination, right ascension, time,	
UNIT-V Planetary motions	**(18 Hours)**
Kepler's I, II and III laws, Newton's law of gravitation, perturbations and principles of orbital motion, equation of the orbit, velocity of a planet in its orbit, components of the linear velocity, true and eceentric anomalies, Kepler's equation and solution, eccentric anomalies expressed as a series in term of e and eccentric anomaly, equation of the centre, orbit in space, heliocentric ecliptic rectangular coordinates ofa planet, heliocentric equatorial coordinates of a planet, heliocentric rectangular coordinates of earth, Planet's geocentric right ascension and declination, orbital and synodic periods, earth's orbit, sun's apparent orbit, Moon's orbit	
TEXT BOOK(S)	
1.W.M.Samart, Text Book on Spherical Astronomy, Cambridge University Press, 1949.. Unit-I:Chapters 1; Unit-II: Chapters 2; Unit-III: Chapter 3; Unit-IV: Chapters 4; Unit-V: Chapters 5	
REFERENCE BOOKS **1.**Edgar W.Woolard and Gerald M.Clemence, Spherical Astronomy, Academic Press, 1966.	

Astronomy – 213MAT2107

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Spherical Triangles, Length of Small circle arc, Terrestrial Latitude and Longitude, Fundamental Formula,
2		➢ Sine Formula, Formula C, Four parts Formula, Alternative Proofs of the formula A, B, C, Right angled, Quadrantal triangles
3		➢ Polar Formula, Haversine Formula, Trignometrical ratios of small angles, Delambres and Napier's analogies, Examples
4	**Unit – 2**	➢ Altitude and Azimuth, Declination and Hour angle, Diagram for the southern hemisphere, Circumpolar stars, geocentric celestial sphere, solution of the spherical triangle PZX
5		➢ Right ascension and declination, earth's orbit, celestial latitude and longitude, sidereal time, Mean solar time,
6		➢ Hour angle of a heavenly body, rising and setting, rate of change of zenith distance and azimuth, Twilight
7	**Unit – 3**	➢ Laws of refraction, refraction for small Zenith Distances,
8		➢ general formula for refraction, effect of refraction on the time of sunset,
9		➢ Effect of refraction on the right ascension and declination of star, Examples
10	**Unit – 4**	➢ General Description and instrumental errors, Azimuth error and level error and their determinations, collimation error, , ,
11		➢ total correction to the observed time of transit, Bessel's formula
12		➢ wire intervals, chronograph, measurement of declination, right ascension, time
13	**Unit – 5**	➢ Kepler's I, II and III laws, Newton's law of gravitation, perturbations and principles of orbital motion, equation of

		the orbit, velocity of a planet in its orbit, components of the linear velocity, true and eceentric anomalies,
14		➢ Kepler's equation and solution, eccentric anomalies expressed as a series in term of e and eccentric anomaly, equation of the centre, orbit in space, heliocentric ecliptic rectangular coordinates ofa planet,
15		➢ heliocentric equatorial coordinates of a planet, heliocentric rectangular coordinates of earth, Planet's geocentric right ascension and declination, orbital and synodic periods, earth's orbit, sun's apparent orbit, Moon's orbit

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213MAT2105	Financial Mathematics	L	T	P	X	H	C
		3	1	0	0	4	4

COURSE OBJECTIVE

To enable the students to understand the basic concepts of finance and risk management and modeling financial assets in discrete-time markets and continuous-time markets and Black-Scholes and binomial models and their properties.

COURSE OUTCOMES

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

CO1 know about finance and risk management

CO2 understand modeling financial assets in discrete-time market models

CO3 know about binomial model and its properties

CO4 understand modeling financial assets in continuous-time market models

CO5 know about continuous-time market of Black-Scholes models

CO – PO MAPPING:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		**M**										
CO2		**M**							**L**		**M**	**L**
CO3		**M**										
CO4		**M**									**M**	
CO5		**M**							**L**		**M**	

*S – Strong; M – Medium; L – Low

UNIT-I: Financial and Risk Management	**(18 Hours)**
Basic Financial Derivatives: Future and Forward Contracts, Eisenberg Noo Model, Vanilla call and	

Put options, American Options, Bond and Forward Rate Agreements, credit derivatives, Optimization in Finance, No Dominance Principle and Model Independent Arbitrage
UNIT-II: Market Models **(18 Hours)**
Arrow Debreu Market Model: Arbitrage Portfolio and Fundamental Theorem of Asset Pricing, Market Model with risk free bond, one period binomial model, one period trinomial model, replication and complete Market, superreplication and Model Risk, Multiperiod Discrete Time Models: sample space for multiperiod asset price process, arbitrage and trading in multiperiod discrete time markets
UNIT-III: Binomial Model **(18 Hours)**
Binomial Model: No arbitrage condition, Basic Properties, Arbitrage Pricing and replicating European contingent claims, Dividend paying stock, Calibrating the parameters of the Model to Market Data
UNIT-IV: Various Continuous Time Markets **(18 Hours)**
Trading and Arbitrage, Bacheller's Continuous Time Market, Limit of Binomial under risk neutral probability, pricing contingent claims, Delta hedging, completeness, Error of Discrete Hedging, Time Varying Black Scholes (B.S)
UNIT-V Continuous Time Markets of Black Scholes **(18 Hours)**
Yield Curve and Forward interest rate, Browning Motion, Physical Versus Risk Neutral, B.S Partial Differential Equation, Numerical Methods for the Price of a European Option, Stock Price with Dividend in B.S
TEXT BOOK(S)
1.Arash Fahim, Introduction to Financial Mathematics Concepts and Computational Methods, Copyright © 2019, Arash Fahim Unit-I:Chapters 1; Unit-II: Chapters 2, Sections 2.1 and 2.2; Unit-III: Chapter 2, Sections 2.3 to 2.4; Unit-IV: Chapters 3, Sections 3.1, 3.2, 3.3.1 to 3.3.6; Unit-V: Chapters 3, Sections 3.3.7 to 3.3.12
REFERENCE BOOKS 1.H. Föllmer and A. Schied, Stochastic finance: an introduction in discrete time, Walter de Gruyter, 2011. 2. J. Franke, W. K. Härdle, and C. M. Hafner, Statistics of financial markets, vol. 2, Springer, 2004. 3. P. Glasserman, Monte Carlo methods in financial engineering, vol. 53, Springer Science & Business Media, 2003 4.J. Hull, Options, Futures and Other Derivatives, Options, Futures and Other Derivatives, Pearson/Prentice Hall, 2015. 5. I. Karatzas and S. Shreve, Brownian motion and stochastic calculus, vol. 113, Springer Science & Business Media, 2012.

Financial Mathematics – 213MAT2105

Week	Unit	Lecture Topic
1	**Unit – 1**	Basic Financial Derivatives: Future and Forward Contracts, Eisenberg Noo Model,
2		➢ Vanilla call and Put options, American Options, Bond and Forward Rate Agreements
3		➢ credit derivatives, Optimization in Finance, No Dominance Principle and Model Independent Arbitrage

4	**Unit – 2**	➢ Arrow Debreu Market Model: Arbitrage Portfolio and Fundamental Theorem of Asset Pricing, Market Model with risk free bond
5		➢ one period binomial model, one period trinomial model, replication and complete Market, superreplication and Model Risk,
6		➢ Multiperiod Discrete Time Models: sample space for multiperiod asset price process, arbitrage and trading in multiperiod discrete time markets
7	**Unit – 3**	➢ Binomial Model: No arbitrage condition, Basic Properties, ,
8		➢ Arbitrage Pricing and replicating European contingent claims, Dividend paying stock
9		➢ Calibrating the parameters of the Model to Market Data
10	**Unit – 4**	➢ Trading and Arbitrage, Bachelier's Continuous Time Market, Limit of Binomial under risk neutral probability
11		➢ pricing contingent claims, Delta hedging
12		➢ completeness, Error of Discrete Hedging, Time Varying Black Scholes (B.S)
13	**Unit – 5**	➢ Yield Curve and Forward interest rate, Browning Motion
14		➢ Physical Versus Risk Neutral, B.S Partial Differential Equation
15		➢ Numerical Methods for the Price of a European Option, Stock Price with Dividend in B.S

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		L	T	P	X	H	C
213MAT2106	**Algorithmic Graph Theory**	3	1	0	0	4	4

Course objective:

To enable the students to explores the knowledge of graph algorithms which is useful in computer networks and analysis.

Course Outcomes:

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

1. learn the basic concepts of Graph.
2. gain the knowledge of Graph Platforms, Processing and Search Algorithms.
3. know about the Centrality Algorithms.
4. learn the concept of Community Detection Algorithms.
5. develop the knowledge about Graph Algorithms for Practice.

CO -PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	S			S								S
CO2				M							S	
CO3		S									S	
CO4			S							S		
CO5	S	S		L			S			S		M

S- Strong; M-Medium; L– Low.

UNIT-I: Basics of Graph Algorithm	**(18 Hours)**
Graph Analytics and Algorithms, Graph Processing, Databases, Queries, and Algorithms, OLTP and OLAP, Graph Analytics Use Cases, Graph Types and Structures, Random, Small-World, Scale-Free Structures, Flavors of Graphs, Connected Vs Disconnected Graphs, Unweighted Graphs Vs Weighted Graphs, Undirected Graphs Vs Directed Graphs Acyclic Graphs Vs Cyclic Graphs, Sparse Graphs Vs Dense Graphs, Monopartite, Bipartite, and k-Partite Graphs, Pathfinding, Centrality, Community Detection	
UNIT-II: Graph Platforms, Processing and Search Algorithms	**(18 Hours)**
Graph Platforms and Processing, Graph Platform and Processing Considerations, Transport Graph, Importing the Data into Apache Spark and Neo4j, BFS &DFS, Shortest Path Variation: A, Single Source Shortest Path, Single Source Shortest Path with Apache Spark &Neo4j, Minimum Spanning Tree, Minimum Spanning Tree with Neo4j, Random Walk with Neo4j	
UNIT-III: Centrality Algorithms	**(18 Hours)**
Graph Data: The Social Graph, Importing the Data into Apache Spark & Neo4j, Degree Centrality with Apache Spark, Closeness Centrality with Apache Spark & Neo4j, Closeness Centrality Variation: Wasserman and Faust, Harmonic Centrality, Betweenness Centrality, Betweenness Centrality with Neo4j, Randomized-Approximate Brandes, PageRank Formula,, Random Surfers, and Rank Sinks PageRank Apache Spark & Neo4j, Personalized PageRank	
UNIT-IV: Community Detection Algorithms	**(18 Hours)**
Software Dependency Graph, Importing the Data into Apache Spark& Neo4j, Triangle Count, Clustering Coefficient- Local Vs Global, Triangle Count with Apache Spark & Neo4j, Local Clustering Coefficient with Neo4j, Strongly/Normally Connected components with Apache Spark & Neo4j Label Propagation, Semi-Supervised Learning and Seed Labels, Label Propagation with Apache Spark& Neo4j, Louvain Modularity with Neo4j, Validating Communities	
UNIT-V : Graph Algorithms for Practice	**(18 Hours)**
Analyzing Yelp Data with Neo4j, Yelp Social Network, Data Import, Graph Model, Overview of the Yelp Data, Trip Planning App, Travel Business Consulting, Finding Similar Categories, Analyzing Airline Flight Data with Apache Spark, Exploratory Analysis, Popular Airports, Delays from ORD Bad Day at SFO, Interconnected Airports by Airline	
TEXT BOOK(S)	
1 Mark Needham and Amy E. Hodler, Graph Algorithms Practical Examples in Apache Spark & Neo4j, Published by O'Reilly Media, Inc. 2019. Unit-I:Chapters 1 & 2; Unit-II: Chapters 3 &4; Unit-III: Chapter 5,; Unit-IV: Chapter 6; Unit-V: Chapters 7	
REFERENCE BOOKS 1.Shimon Even, ***Graph Algorithms,*** **Computer Science Press, 1979.**	

Algorithmic Graph Theory – 213MAT2106

Week	Unit	Lecture Topic
1	**Unit – 1**	➢ Graph Analytics and Algorithms, Graph Processing, Databases, Queries, and Algorithms
2		➢ OLTP and OLAP, Graph Analytics Use Cases, Graph Types and Structures, Random, Small-World, Scale-Free Structures, Flavors of Graphs, Connected Vs Disconnected Graphs, Unweighted Graphs Vs Weighted Graphs, Undirected Graphs Vs Directed Graphs
3		➢ Acyclic Graphs Vs Cyclic Graphs, Sparse Graphs Vs Dense Graphs, Monopartite, Bipartite, and k-Partite Graphs, Pathfinding, Centrality, Community Detection
4	**Unit – 2**	➢ Graph Platforms and Processing, Graph Platform and Processing Considerations, Transport Graph,
5		➢ Importing the Data into Apache Spark and Neo4j, BFS &DFS, Shortest Path Variation: A, Single Source Shortest Path,
6		➢ Single Source Shortest Path with Apache Spark &Neo4j, Minimum Spanning Tree, Minimum Spanning Tree with Neo4j, Random Walk with Neo4j
7	**Unit – 3**	➢ Graph Data: The Social Graph, Importing the Data into Apache Spark & Neo4j, Degree Centrality with Apache Spark, Closeness Centrality with Apache Spark & Neo4j,
8		➢ Closeness Centrality Variation: Wasserman and Faust, Harmonic Centrality, Betweenness Centrality, Betweenness Centrality with Neo4j, Randomized-Approximate Brandes
9		➢ PageRank Formula,, Random Surfers, and Rank Sinks PageRank Apache Spark & Neo4j, Personalized PageRank
10	**Unit – 4**	➢ Software Dependency Graph, Importing the Data into Apache Spark& Neo4j, Triangle Count, Clustering Coefficient- Local Vs Global, Triangle Count with Apache Spark & Neo4j,
11		➢ Local Clustering Coefficient with Neo4j, Strongly/Normally Connected components with Apache Spark & Neo4j
12		➢ Label Propagation, Semi-Supervised Learning and Seed Labels, Label Propagation with Apache Spark& Neo4j, Louvain Modularity with Neo4j, Validating Communities
13	**Unit – 5**	➢ Analysing, Yelp Data with Neo4j, Yelp Social Network, Data Import, Graph Model, Overview of the Yelp Data
14		➢ Trip Planning App, Travel Business Consulting, Finding Similar Categories, Analyzing Airline Flight Data with Apache Spark
15		➢ Exploratory Analysis, Popular Airports, Delays from ORD Bad Day at SFO, Interconnected Airports by Airline

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212MAT1304	BASIC LATEX	L	T	P	X	H	C
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Course Objective(s):

To enable the students to understand the basic concepts of tex and to create figures, tables and specialized graphics using latex typesetting commands.

Course Outcome(s):

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

CO1: explain the difference between the use of tex and latex and other software.

CO2: write a mini document and a certificate.

CO3: draw tables and figures using latex.

CO4: write the bibliography for an article and also enable to provide cross references.

CO5: write mathematical documents using the mathematical formulae.

CO -PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			S								S
CO2				M							S	
CO3		S									S	
CO4			S							S		
CO5	S	S		L			S			S		M

S- Strong; M-Medium; L– Low.

UNIT-I:	**(3 Hours)**
Introduction - What is Latex? – History – More about Latex – Advantages of Latex – Disadvantages of Latex – Simple document: Getting started – A short simple document – Document class and font size – Add on packages – Geometry parameters – Title and author(s) – To make an index – Begin document: No complicating features – some simple rules – spaces overlooked – Indent and noindent – Commands, arguments and curly brackets – comments.	
UNIT-II:	**(3 Hours)**
Geometry Parameters – Sectioning into chapters and sections – Quotation marks, new paragraphs and pages – Different fonts and font sizes – Format: Centre, left and right – List of items – Landscape format – Double column entries – Multiple column entries – Mini page – Special characters – Boxes – Rotating – How to type a certificate in latex.	
UNIT-III:	**(3 Hours)**

Figures and tables –Figures : Import figures – Reflection of figures – To generate figures by latex coding. Tables : Simple tables – Multicolumn, Multirow tables – Tables in the landscape format – placing figures and tables side by side.	
UNIT-IV:	**(3 Hours)**
Cross References and Bibliography : Cross referencing : Pages, equations, figures and tables . Bibliography : A simple case – bibliographic data bases – bibliographic styles – bibtex program.	
UNIT-V:	**(3 Hours)**
Mathematical symbols: Special characters – Greek letters - Math mode accents in latex – Some common mathematical symbols – European characters – Transliteration symbols: Sanskrit alphabet. Mathematical expressions and equations : Simple mathematical expressions – Differentiation and Integrations Symbols – Matrices – Boxed equations – Beamer presentation.	
TEXT BOOK(S)	
K.B.M. Nambudiripad, *Latex for Beginners*, Alpha Science International Ltd., 2014	
REFERENCE BOOK(S)	
1. Stefankotwitz and Olten, *Latexbegineers guide*, Birmingham: Packt publishers, 2011. 2. GeorgeGratzer, *Practical Latex*, Springer, 2014.	

BASIC LATEX– 212MAT1304

Week	Unit	Lecture Topic
1	Unit - 1	➢ Introduction - What is Latex? – History – More about Latex – Advantages of Latex – Disadvantages of Latex – Simple document : Getting started – A short simple document
2		➢ Document class and font size – Add on packages – Geometry parameters – Title and author(s) – To make an index – Begin document : No complicating features
3		➢ some simple rules – spaces overlooked – Indent and noindent – Commands, arguments and curly brackets – comments.
4	Unit - 2	➢ Geometry Parameters – Sectioning into chapters and sections – Quotation marks, new paragraphs and pages – Different fonts and font sizes
5		➢ Format : Centre, left and right – List of items – Landscape format – Double column entries
6		➢ Multiple column entries – Mini page – Special characters – Boxes – Rotating – How to type a certificate in latex .
7	Unit - 3	➢ Figures and tables –Figures : Import figures – Reflection of figures

8		➢ To generate figures by latex coding. Tables : Simple tables – Multicolumn, Multirow tables
9		➢ Tables in the landscape format – placing figures and tables side by side.
10	**Unit - 4**	➢ Cross References and Bibliography : Cross referencing : Pages, equations, figures and tables .
11		➢ Bibliography : A simple case – bibliographic data bases
12		➢ bibliographic styles – bibtex program.
13	**Unit - 5**	➢ Mathematical symbols: Special characters – Greek letters - Math mode accents in latex – Some common mathematical symbols
14		➢ European characters – Transliteration symbols: Sanskrit alphabet. Mathematical expressions and equations :
15		➢ Simple mathematical expressions – Differentiation and Integrations Symbols – Matrices – Boxed equations – Beamer presentation.

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