Curriculum

Of

... B.Sc. (Hon's) in Mathematics ...

Faculty of Science

Academic Year 2020-2021

Department of Mathematics

Bangamata Sheikh Fojilatunnesa Mujib
Science and Technology University

Melandha, Jamalpur-2012, Bangladesh

Programme Summary

BSc (Hons) in Mathematics

1	Title of the Program	Bachelor of Science (Honours) in Mathematics BSc (Hons) in Mathematics
2	Name of the University/ Awarding institution	Bangamata Sheikh Fojilatunnesa Mujib Science & Technology University
3	Name of the Degree	BSc (Hons) in Mathematics
4	Name of the Faculty	Faculty of Science
5	Name of the Department offering the program	Department of Mathematics
6	Academic year	2020-2021
7	Program Duration	4-Years 8 Bi-semester
8	Total credit requirement	154
9	Language of study	English
10	Mode of study	Full Time

Contents

0.1 Vision of the University

Bangamata Sheikh Fojilatunnesa Mujib Science and Technology University aspires to be the country's centre of excellence in transformation and continuous advancement in STEAM education, knowledge, research, creativity, and entrepreneurship.

0.2 Mission Statements of the University

Mission statements of the Institution are
IMS 1: To advance learning and expertise of science, technology, engineering, the arts, and mathematics by education and research.
IMS 2: To serve as a hub for knowledge creation, technical advancement, and transition among academia, business, and society in a sustainable manner.
IMS 3: To prepare graduate imbued with skills in Fundamental, Social, Thinking, and Personal dimensions for transforming Bangladesh into a nation with sustained economic growth and equitable social progress.

General objective: The general objective of BSFMSTU is to create graduates who will serve the society and contribute for sustainable development leading to achieve the national goals with their wisdom, creativity, research, entrepreneurship, human values, abilities and patriotism.

0.3 Vision of the Program Offering Department

The vision of the department is to aspire to reach the country's centre of excellence in conducting mathematical research and education.

0.4 Mission of the Program Offering Department

The department works with the mission:
to excel in conducting research which would have local and global impact and recognition;
to provide teaching-learning opportunities of mathematics;
to produce skilled mathematics graduates for serving the needs of national and international communities; and
to undertake educational outreach and community engagement that increases mathematical, rational and computing literacy nationally and globally.

0.5 Description of the Program

The department offers a 4-year Bachelor of Science in Mathematics (B.Sc. (Hons)) degree which comprises a full spectrum of pure and applied mathematics courses along with a set of allied courses such as English, Computer Science, Physics, Statistics, Economics, Accounting, Environmental Science and Bangladesh Studies. The B.Sc. (Hons) in Mathematicians is mapped to diverse careers in teaching, public service, IT industry, data science, banking, finance and more. Students of the department get benefit from small class sizes, frequent interactions with faculty members, financial support, and access to extracurricular activities, including the Math Club, Programming Club, Language, Cultural and Debating Club. The department arranges seminars, workshops and training programs on a regular basis to enlighten and enhance the skill of students and teachers.

0.6 Program Educational Objectives (PEO)

The program education objectives of the department of mathematics take into consideration the university mission and the constituents' needs by producing graduates who, in their first few years after graduation, will be able to

PEO1 Advance in their careers, adapting to new situations and emerging problems, through the application of general purpose mathematics knowledge, skills and the core technical disciplines, analytical procedures, and design practices of the mathematics profession;

PEO2 Function ethically in a variety of professional roles as a mathematics graduate through sustainable approach;

PEO3 Utilize modern tools, professional skills such as effective communication, team-work, and leadership; and able to demonstrate entrepreneurship skills and recognize the need of life-long learning for successful career advancement.

PEO4 Demonstrate an understanding of the critical role play in the working place, industry as well as society with respect to health, safety, and the environment in tangible ways such as achieving professional excellence.

0.7 Program Learning Outcomes (PLO)

Program Outcomes: The Program Outcomes (POs) of B.Sc. in Mathematics are to:

PO1. **Subjective knowledge** (Cognitive): Acquire and apply the knowledge of mathematics, science, fundamentals and specialization to the solution of complex problems related in mathematics;

PO2. **Problem analysis** (Cognitive): Identify, formulate, research and analyse complex mathematical problems and provide creative, innovative and effective solution to reach substantiated conclusions using the principles of mathematics, the natural sciences and statistics;

PO3. **Design/development of solutions** (Cognitive, Affective): Design solutions for complex mathematical problems and design system components or processes to meet the specified needs with appropriate consideration for public health and safety and of cultural, societal and environmental concerns;

PO4. **Investigation** (Cognitive, Psychomotor): Conduct investigations of complex problems, considering experimental design, data analysis and interpretation and information synthesis to provide valid conclusions;

PO5. **Modern tool usage** (Psychomotor, Cognitive): Create, select and apply appropriate techniques, resources and modern IT tools, including prediction and modelling, to complex mathematics problems in the society, scientific activities with an understanding of their limitations;

PO6. **The profession and society** (Affective): Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent re-

sponsibilities relevant to professional practice;

PO7. **Environment and sustainability** (Affective, Cognitive): Understand the impact of problems and solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development;

PO8. **Ethics** (Affective): Apply ethical principles and commit to the professional ethics, responsibilities and the norms of the engineering practice;

PO9. **Individual work and teamwork** (Psychomotor, Affective): Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings;

PO10. **Communication** (Psychomotor, Affective): Communicate effectively about activities with the expert and professional community; and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions;

PO11. **Project management and finance** (Cognitive, Psychomotor): Demonstrate knowledge and understanding management principles and apply these to one's work as a team member or a leader to manage projects in multidisciplinary environments;

PO12. **Life-long learning** (Affective, Psychomotor): Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological and theoretical change.

0.8 Generic Skills/Graduate profile

The department of mathematics strives to attain the outcomes and support students for growth of continuous development for more knowledge and understanding, better cognitive and personal skills and personal and professional development. Broadly, learners are expected to be able to continue to perform to an improved level in their working life and further education (lifelong learning).
Students need the following generic abilities for the twenty-first century:

■ Foundational Literacies	■ Competencies	■ Character Qualities
1. Literacy	7. Critical thinking/ problem-solving	11. Curiosity
2. Numeracy	8. Creativity	12. Initiative
3. Scientific Literacy		13. Persistence/grit
4. ICT literacy	9. Communication	14. Adaptability
5. Financial Literacy	10. Collaboration	15. Leadership
6. Cultural and civic literacy		16. Social and cultural awareness

The three generic ability domains are described in the following ways:
■ Foundational Literacies - How students adapt key skills to daily activities
■ Competencies -Students' approaches to complex problems
■ Character Qualities/Personality Characteristics- How students respond to changes in their environment?

0.9 Mapping/Alignment University's Mission vs PEO

+	IMS1	IMS2	IMS3
PEO 1	×	×	
PEO 2		×	
PEO 3		×	
PEO 4			×

Table 3: Mapping Mission Vs PEOs

0.10 Mapping/Alignment PEO vs PLO

+	PEO 1	PEO 2	PEO 3	PEO 4
PO 1	×	×	×	
PO 2		×		
PO 3		×		
PO 4			×	×
PO 5			×	×
PO 6			×	×
PO 7			×	×
PO 8			×	×
PO 9			×	×
PO 10			×	×
PO 11			×	×
PO 12			×	×

Table 4: Mapping PEO Vs POs

0.11 Mapping/Alignment PEO vs PLO

+	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO 1	3	2	3	1	3	2	3	1	1	2	3	2
PEO 2	3	2	3	3	1	2	3	3	2	2	3	2
PEO 3	3	2	3	1	1	2	3	1	1	2	3	2
PEO 4	3	2	3	3	1	2	3	3	2	2	3	2

(Relation strength: 3-High, 2-Medium, 1-Low, Blank-No relation)

Table 5: Alignment of PEO Vs PLOs

0.12 Year and Semester wise Course Scheme

Course List and Credit distribution for B.Sc (Hons) in Mathematics Degree

Total Credit: 154

First Year First Semester

Sl	Course Code	Course Title	Credit
1	MAT 1111	Fundamentals of Mathematics	3
2	MAT 1121	Two Dimensional Geometry	3
3	MAT 1131	Differential Calculus	3
4	STA 1141	Principles of Statistics	3
5	GED 1151	Bangladesh Studies	3
6	CSE 1161	Fundamental of Computer Science	2
7	CSE 1162	Computer Fundamentals Lab	1
8	MAT 1170	Viva-Voce	1
		Total	19

First Year Second Semester

Sl	Course Code	Course Title	Credit
1	MAT 1211	Algebra and Trigonometry	3
2	MAT 1221	Three Dimensional Geometry	3
3	MAT 1231	Integral Calculus	3
4	PHY 1241	Mechanics, Properties of Matter, Wave and Sound	3
5	ENG 1251	Functional English	3
6	STA 1261	Probability and Probability Distribution	2
7	CSE 1272	Structured Programming Lab using C++	2
8	MAT 1280	Viva-Voce	1
		Total	20

Second Year First Semester

Sl	Course Code	Course Title	Credit
1	MAT 2111	Theory of Matrices	2
2	MAT 2121	Linear Algebra	2
3	MAT 2131	Advanced Calculus	3
4	MAT 2141	Ordinary Differential Equation	3
5	PHY 2151	Heat,Thermodynamics and Optics	3
6	ECO 2161	Principles of Economics	3
7	MAT 2172	Object Oriented Programing Lab	2
8	MAT 2180	Viva-Voce	1
		Total	19

Second Year Second Semester

Sl	Course Code	Course Title	Credit
1	MAT 2211	Vector Calculus	3
2	MAT 2221	Tensor Analysis	2
3	MAT 2231	Real Analysis-I	3
4	PHY 2241	Electromagnetism, and Modern Physics	3
5	PHY 2242	Physics Lab	1
6	STA 2251	Mathematical Statistics	3
7	STA 2252	Statistical package Lab (R/SAS/STATA/Eviews)	2
8	ACT 2261	Accounting, Business and Entrepreneurship	3
9	MAT 2270	Viva-Voce	1
		Total	21

Third Year First Semester

Sl	Course Code	Course Title	Credit
1	MAT 3111	Real Analysis-II	3
2	MAT 3121	Complex Analysis	3
3	MAT 3131	Mechanics	3
4	MAT 3141	Partial Differential Equation	3
5	MAT 3151	Mathematical Method-I	2
6	CSE 3161	Relational Database Management System (RDBMS)	2
7	CSE 3162	RDBMS Lab (Oracle/ MySQL/ SQL Server/ and PL SQL)	2
8	MAT 3170	Viva-Voce	1
		Total	19

Third Year Second Semester

Sl	Course Code	Course Title	Credit
1	MAT 3211	Mathematical Method - II	2
2	MAT 3221	Discrete Mathematics and Graph theory	3
3	MAT 3231	Numerical Analysis	3
4	MAT 3241	Abstract Algebra	3
5	MAT 3251	Classical Mechanics	3
6	FIN 3261	Managerial Finance	3
7	MAT 3272	Numerical Simulation Lab Using Matlab/ Python	2
8	MAT 3280	Viva-Voce	1
		Total	20

Fourth Year First Semester

Sl	Course Code	Course Title	Credit
1	MAT 4111	Hydrodynamics	3
2	MAT 4121	Quantum Mechanics	3
3	MAT 4131	Differential Geometry	3
4	MAT 4141	Integral Equation	3
5	MAT 4151	Topology	3
6	MAT 4162	Mathematical Modeling Lab using FORTRAN/ Matlab	2
7	MAT 4170	Viva-Voce	1
		Total	18

Fourth Year Second Semester

Sl	Course Code	Course Title	Credit
1	MAT 4211	Operation Research	3
2	MAT 4221	Astronomy	3
3	MAT 4231	Special Theory of Relativity	3
4	MAT 4241	Theory of Number	3
5	MAT 4242	Operation Research and Cryptography Lab	2
6	MAT 4253	Project in Mathematics	3
7	MAT 4260	Viva-Voce	1
		Total	18

0.13 Mapping/Alignment PEO vs Types of Courses

0.14 Description of Courses

■ General Course	■ Core Courses	■ Optional/Elective Courses
1. Arts and Humanities	1. Major	1. Major
2. Social Sciences	2. Minor	2. Minor
3. ICT		
4. Basic science		

0.15 Grading and Evaluation

The letter grading system for evaluating student achievement would be as follows:

Marks	Letter Grade (LG)	Grade Point (GP)
80% or above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40% to less than 45%	D	2.0
less than 40%	F	0.0
Incomplete	I	0.0

Incomplete course (letter grade 'I') shall be awarded for courses in subsequent semester.

0.15.1 Assessment Pattern

CIE- Continuous Internal Evaluation

CIE- Continuous Internal Evaluation				
Bloom's Category	Test/Quizzes Midterm	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination

SEE-Semester End Examination

Bloom's Category	Semester Final Examination Marks (70)
Remember	10
Understand	15
Apply	25
Analyze	15
Evaluate	5
Create	-
Total	70

☒ **Note:** In the case of CIE and SEE the marks allocation for the various learning domains can very depending on the course learning outcomes defined for subjects.

Grading related policy

1. Grade Point Average (GPA) and its calculation procedures
2. Course Withdrawal
3. Incomplete (I) courses
4. Retaking/back-log courses
5. Grade Change
6. Course Dropout

0.16 Careers of Mathematics Graduates

Careers Opportunities for Mathematics Graduates

Careers of Mathematics Graduate	Requirement of additional degrees or Supplementary Courses
Mathematics Teacher (University, College, School) Research Scientist (Mathematics)	PhD in Mathematics Proven research ability
Government Service (Academic, Administration and Other cadre services)	Bangladesh Studies; International and current affairs; Bengali and English language and literature. Qualify BCS Examination
Software engineer/Computer programmer Data analyst/Data Scientist Machine Learning Engineer	Structured programming Data Structured and Algorithms OOP using C++/Java/Python DBMS/RDBMS, SQL and Pl/SQL R-Stat/SAS/Stata Etc.
Actuarial analyst/Actuary Insurance Underwriter Financial Analyst/ Investment Analyst Chartered accountant Banking Job Business owner and entrepreneur	Mathematical Finance Actuarial Mathematics Economics Accounting (In some cases it is required to qualify Professional Exam.)
Operational Researcher Meteorologist	M.Sc in Mathematics with related subject M.Sc in Mathematics with related subject

Table 8: Job Opportunities of Mathematics Graduates

Chapter 1

Course Scheme

1.1 Scheme of 1st Year 1st Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 1111	Fundamentals of Mathematics	3	30	70	100
2	MAT 1121	Two Dimensional Geometry	3	30	70	100
3	MAT 1131	Differential Calculus	3	30	70	100
4	STA 1141	Principles of Statistics	3	30	70	100
5	GED 1151	Bangladesh Studies	3	30	70	100
6	CSE 1161	Fundamental of Computer Science	2	30	70	100
7	CSE 1162	Computer Fundamentals Lab	1	50	50	100
8	MAT 1170	Viva-Voce	1	-	100	100
		Total Credits	19			

Table 1.1: Courses of 1st Year 1st Semester

1.2 Scheme of 1st Year 2nd Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 1211	Algebra and Trigonometry	3	30	70	100
2	MAT 1221	Three Dimensional Geometry	3	30	70	100
3	MAT 1231	Integral Calculus	3	30	70	100
4	PHY 1241	Mechanics, Properties of Matter, Wave and Sound	3	30	70	100
5	ENG 1251	Functional English	3	30	70	100
6	STA 1261	Probability and Probability Distribution	2	30	70	100
7	CSE 1272	Structured Programming Lab using C++	2	50	50	100
8	MAT 1280	Viva-Voce	1	-	100	100
		Total Credits	20			

Table 1.2: Courses of 1st Year 2nd Semester

1.3 Scheme of 2nd Year 1st Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 2111	Theory of Matrices	2	30	70	100
2	MAT 2121	Linear Algebra	2	30	70	100
3	MAT 2131	Advanced Calculus	3	30	70	100
4	MAT 2141	Ordinary Differential Equation	3	30	70	100
5	PHY 2151	Heat,Thermodynamics and Optics	3	30	70	100
6	ECO 2161	Principles of Economics	3	30	70	100
7	MAT 2172	Object Oriented Programing Lab	2	50	50	100
8	MAT 2180	Viva-Voce	1		100	100
		Total Credits	19			

Table 1.3: Courses of 2bd Year 1st Semester

1.4 Scheme of 2nd Year 2nd Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 2211	Vector Calculus	3	30	70	100
2	MAT 2221	Tensor Analysis	2	30	70	100
3	MAT 2231	Real Analysis-I	3	30	70	100
4	PHY 2241	Electromagnetism, and Modern Physics	3	30	70	100
5	PHY 2242	Physics Lab	1	30	70	100
6	STA 2251	Mathematical Statistics	3	30	70	100
7	STA 2252	Statistical package Lab (R/SAS/STATA/Eviews)	2	50	50	100
8	ACT 2261	Accounting, Business and Entrepreneurship	3	30	70	100
9	MAT 2270	Viva-Voce	1	-	100	100
		Total Credits	21			

Table 1.4: Courses of 2nd Year 2nd Semester

1.5 Scheme of 3rd Year 1st Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 3111	Real Analysis-II	3	30	70	100
2	MAT 3121	Complex Analysis	3	30	70	100
3	MAT 3131	Mechanics	3	30	70	100
4	MAT 3141	Partial Differential Equation	3	30	70	100
5	MAT 3151	Mathematical Method-I	2	30	70	100
6	CSE 3161	Relational Database Management System (RDBMS)	2	30	70	100
7	CSE 3162	RDBMS Lab (Oracle/ MySQL/ SQL Server/ and PL SQL)	2	50	50	100
8	MAT 3170	Viva-Voce	1	-	100	100
		Total Credits	19			

Table 1.5: Courses of 3rd Year 1st Semester

1.6 Scheme of 3rd Year 2nd Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 3211	Mathematical Method - II	2	30	70	100
2	MAT 3221	Discrete Mathematics and Graph theory	3	30	70	100
3	MAT 3231	Numerical Analysis	3	30	70	100
4	MAT 3241	Abstract Algebra	3	30	70	100
5	MAT 3251	Classical Mechanics	3	30	70	100
6	FIN 3261	Managerial Finance	3	30	70	100
7	MAT 3272	Numerical Simulation Lab Using Matlab/ Python	2	50	50	100
8	MAT 3280	Viva-Voce	1		100	100
		Total Credits	20			

Table 1.6: Courses of 3rd Year 2nd Semester

1.7 Scheme of 4^{th} Year 1^{st} Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 4111	Hydrodynamics	3	30	70	100
2	MAT 4121	Quantum Mechanics	3	30	70	100
3	MAT 4131	Differential Geometry	3	30	70	100
4	MAT 4141	Integral Equation	3	30	70	100
5	MAT 4151	Topology	3	30	70	100
6	MAT 4162	Mathematical Modeling Lab using FORTRAN/ Matlab	2	50	50	100
7	MAT 4170	Viva-Voce	1		100	100
		Total Credits	18			

Table 1.7: Courses of 4^{th} Year 1^{st} Semester

1.8 Scheme of 4^{th} Year 2^{nd} Semester

Sl. No	Course Code	Course Title	Credits	Marks		
				CIE	SEE	Total
1	MAT 4211	Operation Research	3	30	70	100
2	MAT 4221	Astronomy	3	30	70	100
3	MAT 4231	Special Theory of Relativity	3	30	70	100
4	MAT 4241	Theory of Number	3	30	70	100
5	MAT 4242	Operation Research and Cryptography Lab	2	50	50	100
6	MAT 4253	Project in Mathematics	3	50	50	100
7	MAT 4260	Viva-Voce	1		100	100
		Total Credits	18			

Table 1.8: Courses of 4^{th} Year 2^{nd} Semester

Chapter 2

Courses Description

2.1 1st year 1st semester

2.1.1 MAT 1111 : Fundamentals of Mathematics

Course Code	MAT 1111	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: The course is the study of the philosophical , logical and/or algorithmic basis of mathematics. Fundamentals of mathematics can be conceived as the study of the basic mathematical concepts (set, function, geometrical figure, number, etc.) and how they form hierarchies of more complex structures and concepts, especially the fundamentally important structures that form the language of mathematics (formulas, theories and their models giving a meaning to formulas, definitions, proofs, algorithms, etc.).

Objective: Provide an understanding of the mathematical logic and proposition and logic and their basic operations and properties

Course Outcomes (COs): At the end of the course student will be able to

CO1	Define and discuss mathematical propositions and logic with properties
CO2	Define types of sets and performs set operations and state and proof theorems and related relations
CO3	Discuss number systems with the properties, define field, connectedness and compactness of the number system, bounded set, upper and lower bound
CO4	Define Cartesian product (ordered pair) of two sets, relation, inverse relation, composite relation, domain and rage of relation. Prove related theorem of relations
CO5	Define functions, composition of function, types of function, related theorems on functions.
CO6	Define denumerable and countable sets, cardinal number, ordering of cardinal number, cardinal arithmetic, state and prove Cantor's theorem, apply addition and multiplication of cardinal number
CO7	Define partially ordered set, totally ordered set, subset of ordered set, totally ordered subsets, first and last elements, maximal and minimal elements, upper and lower bound, supremum and infimum.

Mapping of Course Outcomes to Program Outcomes:

+	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	1	2	3	1	1	2	3	1
CO2	3	2		1	1	2	3	1	1	2	3	1
CO3	3	2		1	1	2	3	1	1	2	3	1
CO4	3	2		1	1	2	3	1	1	2	3	1
CO5	3	2			1	2	3	1	1	2	3	1
CO6	3	2		1	1	2	3	1	1	2	3	1
CO7	3	2		1	1	2	3	1	1	2	3	1

(Level of correlation: 3-High, 2-Medium, 1-Low)

Table 2.2: Alignment of COs Vs POs

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 1111 : Fundamentals of Mathematics

Sl No	**Course Content**	Hrs	COs
1	Proposition and compound proposition, Basic logical operation, truth table, tautologies and contradiction, logical equivalence, algebra of proposition, conditional and biconditional statement, argument, logical implication, propositional function and quantifier, negation of quantified statement.	5	CO1
2	Notion of set, finite and infinite set, equality of set, null set, subset, proper subset, set of sets, universal set, power set, disjoint set, Venn-Euler diagram, union and intersection of sets, difference, complement, operations on comparable set.	5	CO2
3	Natural number, Set of integers and rational numbers, the real number system, geometric representation of real number, absolute value and distance, interval and bounded sets of real number, the division algorithm, fundamental theorem of arithmetic, modulus and their properties.	5	CO3
4	Product set and graph of function: Ordered pair, product set, coordinate diagram, graph of a function, graph of coordinate diagram, product set in general	5	CO4
5	Relation: Product set, solution set and graph of relation, inverse relation, reflexive relation, symmetric relation, anti-symmetric relation, transitive relation, equivalence relation	5	CO4
6	Function: Definition of function, domain and range of function, one-one function, onto function, invertible function, set function, associativity and product of function, identity and inverse function, theorems on the inverse function.	5	CO5
7	Cardinal number: denumerable and countable sets, cardinal number, ordering of cardinal number, cardinal arithmetic, Cantor's theorem, addition and multiplication of cardinal number.	5	CO6
8	Partially and totally ordered set: partially ordered set, totally ordered set, subset of ordered set, totally ordered subset, first and last elements, maximal and minimal elements, upper and lower bound, supremum and infimum.	5	CO7

Text Books:
1. Set Theory and related topics : Seymour Lipschutz, Schaum's Outline Series
2. Set Theory and Number Systems : R. S. Agarwal

Recommended Reference Books:
1. Discrete Mathematics and Its Applications : Kenneth H. Rosen
2. Discrete Mathematical Structures : Koleman & Busby

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final Examination: 70 marks. Exam Duration : 3 hours.
Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation

Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination

Bloom's Category	Semester Final Examination Marks (70)
Remember	10
Understand	15
Apply	25
Analyze	15
Evaluate	5
Create	-
Total	70

2.1.2 MAT 1121 :Two Dimensional Geometry

Course Code	MAT 1121	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Geometry is the synthesis of number and form. In algebra, we have geometrical 1st, 2nd, and higher order equations. Algebra can solve geometrical problems, and geometry can solve algebraic problems. As a consequence, geometrical comprehension is important for mathematics students.

Objective: To offer students a firm understanding of two-dimensional geometry principles. co-ordinate Students can hear about co-ordinate , conic, and conic section , translation and

rotation of axis in two dimensions.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Transformation of coordinates: Coordinate and origin, Different types of coordinate, Rectangular System/Axes, Oblique System/Axes, Relation among/between coordinate system, Rotation of rectangular Axes, Transformation of origin, Removal of first degree terms, Removal of xy (Product of x and y) terms, Invariance Theory, some applications of coordinate transformation.
2. Pair of Straight line: Equation of pair of straight line, General equation of second degree and its condition, Equation of bisectors.
3. Circle: Definition of Circle, General equation of circle, Condition of tangency, Pole and polar, Chord of contact, Conjugate point and line, Common tangent, Equation of chord, Equation of chord in terms of its middle point, some applications.
4. System of Circle: Angle of intersection of two circles, Radial axes and properties of radical axes, Co-axial circle, Point circle, Limiting point and properties of limiting point, some examples.
5. Parabola: Standard equation of parabola, Tangent, Normal, Diameter.
6. Ellipse: Standard Equation, Equation of normal and properties, Condition of tangency, Director circle, Focal distance, Eccentric angle, Conjugate diameter and properties, some applications.
7. Hyperbola: Standard Equation, Equation of tangent and properties, Asymptotes, Rectangular hyperbola, Conjugate diameters and properties, Conjugate hyperbola, some examples.
8. Conic section: The general equation of second degree in x and y, Identification of conic and reduction to standard form.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. Analytic Geometry of Conic Sections by J. M. Kar
2. Analytic Geometry of Conic Sections by Askwith H.H.
3. Analytic Coordinate Geometry Loney S. L.
4. Analytic Geometry of Conic Sections by Smith C

2.1.3 MAT 1131 : Differential Calculus

Course Code	MAT 1131	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: The definition of the rate of change of one quantity with respect to another quantity, as well as locating the field, are fundamental problems in the branch of mathematics known as Calculus. Newton and Leibniz developed this subject in the seventeenth century. They had discovered a basic relationship between the problem of deciding the area of a region and the problem of locating a tangent line to a curve. Their knowledge of this relation is known as the "discovery of calculus."

Objective: An introduction to limits and continuity. Examines differentiation concepts with applications to related rates, curve sketching, engineering optimization problems and business applications.

Course Outcomes (COs): At the end of the course student will be able to

CO1	Use methods for determining the limits of algebraic and trigonometric functions. As the independent variable reaches finite values or expands indefinitely. To measure prescribed functions, invoke the concept of continuity at a point. Be able to graphically represent three common problems that contribute to a point of discontinuity.
CO2	Define derivative geometrically, numerically, and analytically (e.g., slope of tangent, limit of variance quotients, extrema, Newton's rule, and instantaneous rate of change) and Demonstrate mastery of basic differentiation formulas and laws.
CO3	Demonstrate mastery of function expansion by using Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's theorem.
CO4	Provide written proof of efficient implementation of curve sketching, including extremal experiments with first and second derivatives. Recognize and apply derivative and partial derivatives applications to solve optimization problems from a range of disciplines, including finance, biology, medicine, and physical sciences.
CO5	Solve problems involving partial differentiation, state and apply Euler's theorem, and apply it.
CO6	Solve problems including Tangent and normal and find the equations of asymptotes

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 1131 : Differential Calculus

Sl No	**Course Content**	Hrs	COs
1	Limit, continuity and differentiability, indeterminate form, L'Hospital's rule, Basic theorems and computation of limit, continuity and differentiability	5	CO1
2	Differentiation: Definition of derivative, Rules of Differentiation, Successive differentiation, Leibnitz theorem and applications.	5	CO2
3	Expansion of function: Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's theorem.	5	CO3
4	Maxima and Minima of functions of one variable: Increasing and decreasing functions, Condition for extreme value of a function, Determination of maxima and minima, inflexion point and applications.	5	CO4
5	Partial differentiation: Partial differentiation, Euler's theorem and application	5	CO5
6	Tangent and normal, asymptotes	5	CO6

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Differential Calculus by Das and Mukherjee
2. Calculus by Howard Anton
3. Differential Calculus by J. Edwards
4. Calculus by F. Ayres
5. Calculus and analytical Geometry by G. B. Topmas and R. L. Finny
6. Calculus and analytical Geometry by S.K.Stein and A.Barcellos
7. Advanced Calculus by M. R. Spigel

2.1.4 STA 1141 : Principles of Statistics

Course Code	STA 1141	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Statistics has played a significant role in the field of Mathematics. This course introduced the basic concepts and methods for analysis of data. It's a fundamental course and helps us to draw conclusion on data.

Objective: The objectives of the course are:
To gain knowledge in Statistics and its application
To develop skills how to collect, organise, summarise and visualize data
To demonstrate the understanding the association of data and sampling design.
Course Outcomes (COs): At the end of the course student will be able to

CO1	Decipher the background of Statistics and its scopes, application.
CO2	Interpret and draw conclusion on the basis of graphical summaries of data.
CO3	Calculate and interpret numerical summary Statistics as well as to have knowledge of important properties of different measures.
CO4	Identify the features (Shape, Spread, and Outliers) that describe the pattern of data and illustrate the impact of skewness and outliers on the various summary Statistics.
CO5	Calculate and interpret the significance of data.
CO6	Forecast time series data with different techniques and calculate index number.
CO7	perform sampling design and determine the sample size.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

STA 1141 : Principles of Statistics

Sl No	**Course Content**	Hrs	COs
1	Statistics: Definition, Scope and Classification of Statistics, its Relation With Mathematics, Limitations, Uses, Misuses of Statistics	3	CO1

2	Processing of Data: Variable and Attribute, Types of Variable, Population and sample, Different Scales: Nominal, Ordinal, interval, Ratio, Sources of Data, Classification and Tabulation of Data, Frequency Distribution, Graphical Representation of Data, Stem and Leaf Display, dot Plot, Box plot.	3	CO2
3	Measures of Central Tendency: Mean, Median, Mode, Quartile, Decile, Percentile with their properties and Application of Measures of Central Tendency.	6	CO3
4	Measures of Dispersion: Absolute and Relative Measures of Variability, Application of Different Measures of Dispersion. Moment and Shape Characteristics of Distribution: Moment, Sheppard's Correction for Grouping Error, Skewness and Kurtosis, Box-Plot.	6	CO4
5	Simple Correlation and regression: Bivariate Data, Scatter Diagram, Simple Correlation, Correlation ratio, Rank Correlation, Simple Linear Regression Analysis.	6	CO5
6	Index Number: Basic concepts, Problem of Index Number, Different types of Index, Error in Index number, Test of Index Number, Cost of Living Index. Time Series: Meaning of Time Series, Component of Time Series, Secular Trend, Cyclical actuation, Seasonal Variation, Irregular Variation.	6	CO6
7	Sample Surveys: Basic Concepts of Sample Survey, Preparation of questionnaire, Schedules, Instruction etc, Survey enumeration, Pilot survey, Requirement of a good sample design, Probability and non- probability sampling, Sampling with and without replacement and with equal and unequal probabilities, Sampling and non sampling errors, Bias, Accuracy and Precision. Probability Sampling: Basic concept of Probability Sampling, Simple Random Sampling, Stratified Random Sampling, Systematic Random Sampling, Cluster Sampling. Non-Probability Sampling: Basic concept of Non-Probability Sampling, Different types of Non-Probability Sampling	6	CO6

Text Books:

1. Lind, A. D., Marchal, W. and Wathen : Statistical Techniques in Business and Economics
2. Bhuyan, K.C : Methods of Statistics. **Recommended References and Books:**

1. Yule and Kendal : An Introduction to the theory of Statistics.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final Examination: 70 marks. Exam Duration: 3 hours. Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation				
Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination	
Bloom's Category	Semester Final Examination Marks (70)
Remember	20
Understand	15
Apply	15
Analyze	15
Evaluate	5
Create	-
Total	70

2.1.5 GED 1151 : Bangladesh Studies

Course Code	GED 1151	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: As a Bangladeshi resident, students should be aware of the country's glorious history as well as current issues. This awareness will make them proud and conscious of their country, which will inspire them to work for it.

Objective: The objectives of the course are to provide students with factual information and analytical skills that will help them to understand and critically understand Bangladesh's history, politics, and economy. It will trace Bangladesh's historical origins as an independent state, concentrating on the social, economic, and political changes that have occurred since its independence. It would also recognize the key socioeconomic, political, environmental, and developmental challenges that have emerged over this time span before measuring change over time.

Course Outcomes (COs): By the end of the course students will be able to

CO1	Discuss the Geography and Demographic Features of Bangladesh in depth.
CO2	Explain the spirit of the Liberation War of Bangladesh and its Background
CO3	Discuss the climate, nature, and natural resources, as well as Bangladesh's economy.

CO4 Discuss the People's Republic of Bangladesh's Constitution, as well as the various modes of government and their organs.
CO5 Address Bangladesh's Foreign Policy and External Affairs
CO6 Explain the formation and function of Bangladesh's major political parties.
CO7 Describe the trade and globalization policies in relation to Bangladesh.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Geography and Demographic features of Bangladesh:
(a) Geography of Bangladesh: Origin of the name of Bangladesh, Geographical location and area, river, weather, culture, Flora and Fauna.
(b) Demographic features: Ethnic and cultural diversity, population by age group, economic divident, society, religions and believes, arts, literature and culture of Bangladesh
2.The Liberation War of Bangladesh and its Background: Participation of Indian subcontinent, Two nation theory, Language Movement 1952, 1954 Election, Education movement 1962,Six-Point Movement, 1966, Mass Upsurge 1968-69, General Elections 1970, Non-cooperation Movement, 1971, Bangabandhu's Historic Speech of 7th March and declaration of independence of Bangladesh. Formation and Functions of Mujibnagar government, Role of Major Powers and of the UN, Surrender of Pakistani Army, Bangabandhu,s return to liberated Bangladesh. Withdrawal of Indian armed forces from Bangladesh.
3. Economy of Bangladesh: Economy with particular emphasis on developments including Poverty Alleviation, GNP, NNP, GDP, SDG, etc. after the emergence of the country.
4. Environment, Nature and Natural resources:
(a) Bangladesh,s environment and nature and challenges and prospects with particular emphasis on conservation, preservation and sustainability.
(b) Natural resources of Bangladesh with focus on their sustainable harnessing and management.
5. The Constitution of the People's Republic of Bangladesh: Preamble, Features, Directive Principles of State Policy, Constitutional Amendments.
6. Forms of Government and its Organ: Types of government, government from liberation war to recent time.
(a) **Legislature:** Representation, Law-making, Financial and Oversight functions; Rules of Procedure, Gender Issues, Caucuses, Parliament Secretariat.
(b) **Executive:** Chief and Real executive e.g., President and Prime Minister, Powers and Functions; Cabinet, Council of Ministers, Rules of Business, Bureaucracy, Secretariat, Law enforcing agencies; Administrative setup- National and Local Government structures, Decentralization Programmes and Local Level Planning.
(c) **Judiciary:** Structure: Supreme, High and other Subordinate Courts, Organization, Powers and functions of the Supreme Court, Appointment, Tenure and Removal of Judges, Organization of Sub-ordinate Courts, Separation of Judiciary from the Executive, Judicial Review, Adjudication, Gram Adalat, Alternative Dispute Resolution (ADR).
7. Foreign Policy and External Relations of Bangladesh: Goals, Determinants and policy formulation process; Factors of National Power; Security Strategies; Geo-Politics and Environment Issues; Economic Diplomacy; Man-power exploitation, Participation in International Organizations; UNO and UN Peace Keeping Missions, NAM, SAARC, OIC, BIMSTEC, D-8 etc, and International Economic Institutions, Foreign Aid, International Trade.
8. Political Parties of Bangladesh: Historical development; Leadership; Social Bases;

Structure; Ideology and Programmes; Factionalism; Politics of Alliances; Inter and Intra-Party Relations; Electoral Behaviour; Parties in Government and Opposition.
9. Trade, Globalization and Bangladesh: Economic and Political Dimensions; Roles of the WTO, World Bank, IMF, ADB, IDB and other development partners and Multi-National Corporations (MNCs).

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. A History of Bangladesh- William Van Schendel, Cambridge University Press 2009
2. History of Bangladesh (1704-1971), Vol-1, Sirajul Islam (Edited), Asiatic Society of Bangladesh.
3. Social History of the Muslims of Bengal (English & Bangla Version)-Abdul Karim
4. Bangladesh National Culture and Heritage- A F Salahuddin Ahmed, BazlulMobinChowdhury (Edited), An Introductory Reader, Independent University Bangladesh.
5. Social & Cultural History of Bengal, Vol-2 (English & Bangla Version)- M.A. Rahim
6. History of Ancient Bengal (In Bangla)- Ramesh Chandra Majumdar.
7. Rise and Decline of the Economy of Bengal- SalauddinAhamed.
8. Social History of Bangladesh, Vol. 3- Sirajul Islam.
9. A Brief History of Bangladesh With Essays on Bangladesh Studies by Dr. S M A Mamun Chowdhury
10. A.M.A Muhit, Bangladesh Emargence of Nation
11. Talukdar Muniruzzaman ,The Politics of development; The case of Pakistan
12. Harun-or-Rashid, The Foreshadowing of Bangladesh; Bengal Muslim League and Muslim Politic, 1906-1947, The University Press Ltd. Dhaka-2012
13. Rounak Jahan, Pakistan; Failure in National Integration, The University Press Ltd. Dhaka-1977
14. Talukder Manurizzaman, Radical Politics and Emergence of Bangladesh, Mowla, Brotheres Dhaka-2003.

2.1.6 CSE 1161 : Fundamental of Computer Science

Rationale: The course describes the learning or studying some basic necessary terms and functions of computer from the beginning to the present day.
Objectives: The objectives of this course are:
1. This course introduces the concepts of computer basics, computer networking, data communication & programming with particular attention to engineering examples.
2. The C programming language is used but the course will stress on fundamental parts of programming language, so that the students will have a basic concept for understanding and using other programming language.

Course Outcomes (COs): By the end of the course student will gain ability to

CO1	Describe the organization of computer and investigate the function of different number systems and their uses in digital architecture
CO2	Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming.
CO3	Explain different types of software and the design process.

CO4 Describe the data management system and some tools used in data processing and storage
CO5 Discuss the systems that make up the Computer Network, network devices and Internet service.
CO6 Write, compile and debug programs in C language and use different data types for writing the programs. Design programs connecting decision structures, loops and functions.
CO7 Explain the process, functions, and applications of artificial intelligence

Contact Hr/Week: 2.0 **(Credit : 2.0)**

CSE 1161 Fundamental of Computer Science

Sl No	**Course Content**	Hrs	COs
1	History, Basic organization of computer, Types of computers: main frame, mini and micro computers; Different types of micro computers, I/O devices; Generation of Computers; Basic Organization and Functional Units, Application. Bit, byte and words; Number systems: Decimal, binary, hexadecimal and octal numbers; Converting from one number system to another number, Computer Coding: Octal and Hexadecimal code, BCD, ASCII, EBCDIC and Unicode Computer arithmetic: why binary, binary arithmetic, addition, subtraction, additive method of subtraction, 1's compliment, 2's compliment, subtraction using 1's and 2's compliment. Logic gates and Boolean algebra: Combinational circuits. Logic gates, AND gate, OR gate, NOT gate, NAND gate, NOR gate, Logic circuits, The universal NAND gate, The universal NOR gate, Exclusive-OR, Equivalence functions, Design of Half-adder, Design of Full-adder. Define FF, Design of half and full adder. Basic counters and register. Basic decoders, encoders, multiplexers and de-multiplexers. ADC and DAC circuits.	6	CO1
2	Fundamentals of computer design. Processor and ALU design. Control design: Hardware control and micro-programmed control. Caches Memory organization. Basic concept of Parallel processing. Basic Units of Computer Hardware; Processor; Input, Output and Memory Devices; Keyboard; Mouse; OMR; OCR; MICR; CD-ROM; Printers; CRT; LCD; LED; Floppy, Scanner, Plotter, Typical Computer Specification.	4	CO2
3	Basic concept of Software, Types of Software; Goals and Components of OS, Types of OS; Familiarization with Various Operating Systems (Windows, DOS, UNIX, Android Etc.); Application Software: Text Processing (MS-WORD); Spreadsheet (MS-EXCEL); Presentation program (MS POWERPOINT), Computer Virus. Definition of S/W Engineering; The classical life cycle; Software process. Software Testing Techniques and Strategies: Testing fundamentals; White box testing; Basis path testing; Loop testing; Black Box testing; Verification and validation;	4	CO3

4	Introduction of Data and Information, Function of DBMS and RDBMS, Data sorting and Indexing, E-R diagram, Data types/Field Types, Query: SQL; Studying various data management system tools like MySQL, MS Access, Oracle; Mathematical and Simulation (Matlab).	4	CO4
5	Introduction of network and network types, Network topologies, bus, star, ring, mesh, and hybrid. Network devices, Data Communications and computer networks, basic elements of a communication system, data transmission modes and Method. Data transmission speed, Basic concept OSI model in networking, Introduction to wireless communication: Hotspot, Bluetooth, WIFI, WIMAX. IP addresses: IPV4 and IPV6, TCP/IP, SMTP, FTP, HTTP, DNS, Email.	6	CO5
6	Programming Language: Machine Language; Assembly Language; High Level Language; Assembler; Translator; Interpreter and Compiler. Overview of C language, C Program structure, Compiler, Interpreter, Application, C Tokens, Keywords, Identifiers, Data types, Constants, Operators, Statements, Expression, Conditional Statements, If and Loops: for, while and do-while	6	CO6
7	Overview of AI. General concepts of knowledge. Introduction to PROLOG. Knowledge representation. Intelligent agents. First order logic. Knowledge organization and manipulation: Search strategies, matching techniques and game planning. Natural language processing, Probabilities reasoning, expert systems and computer vision, Knowledge acquisition: Learning in symbolic and non-symbolic representation.	3	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final Examination: 70 marks. Exam Duration : 3 hours.
Seven questions of equal value will be set, of which five are to be answered. **Recommended Books:**

1. Peter Norton : Introduction to Computer, McGraw-hill Publishers
2. J. Stanley Warford : Computer Systems, Jones & Bartlett Publishers
3. P. Norton : Inside the PC, Sam Publishers
4. L. Rosch : Hardware Bible, Braddy Publishing, Indianapolis
5. Subramanian : Introduction to Computers, Mcgraw-hill Inc.

Assessment Pattern

CIE: Continuous Internal Evaluation				
Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE:Semester End Examination	
Bloom's Category	Semester Final Examination Marks (70)
Remember	10
Understand	15
Apply	25
Analyze	15
Evaluate	5
Create	-
Total	70

2.1.7 CSE 1162 : Computer Fundamentals Lab

Course Code	CSE 1162	CIE Marks	50
Credits	01	SEE Marks	50
SEE Hours	04	Total Marks	100

Rationale: The course will enhance students' skills of using computer and various software packages for academic purposes.
Objectives: The course's objective is to improve students' ability to use a computer system and its different software packages for academic purposes.
Course Outcomes (COs): At the end of the course student will be able to

CO1	Describe different components and its functions of computer systems; and explain different types of software and its functions.
CO2	Operate and Perform Jobs with MS word, Excel, Access and Power Point
CO3	Perform fundamental tasks of editing graphics using Photoshop & illustrators
CO4	Apply Latex to make documents and reports
CO5	Describe various programming languages and write programs in C to execute mathematical operations.

Contact Hr/Week: 2.0 **(Credit : 1.0)**

CSE 1162 : Computer Fundamentals Lab

Sl No	**Course Content**	Hrs	COs
1	Computer system Hardware and Software	4	CO1
2	icrosoft Office Word, Excel, Access and Power Point	6	CO2
3	Photoshop & illustrators	4	CO3
4	Latex	2	CO4
5	Computer Programming with C: Simple input and output. Addition, Subtraction, Multiplication, Division, Finding the value of different functions.	5	CO5

Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (4 hours) Examination: 50 marks.

Recommended Books:

1. E Balaguruswami : Computer Fundamentals

2.1.8 MAT 1170 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.

A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.2 1st year 2nd semester

2.2.1 MAT 1211 : Algebra and Trigonometry

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Inequalities: Weierstrass's Cauchy's and Chebyshev's inequalities, Example with Arithmetic, Geometric and Harmonic means 2. Difference equation, Summation of series. 3. Theory of equation: Fundamental theorem of algebra, Relation between roots and coefficients. Descarte's rule of sign. 4. Solution of cubic and biquadratic equation. 5. Complex number, De-Moivre's theorem and its application. 6. Function of complex argument, Gragory's series. 7. Summation of trigonometric series. 8. Hyperbolic function.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1 Bernard and Child : Higher Algebra
2 Barnside and Panton : Theory of equations
3 Hall and Knight : Higher Algebra
4 Das and Mukherjee : Higher Trigonometry
5 S.A. Sattar : Higher Trigonometry

2.2.2 MAT 1221 :Three Dimensional Geometry

Course Code	MAT 1221	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:
Objectives:
Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Direction-cosine and direction-ratio: Definition, Direction-cosine of a line joining two points, The angle between two directed lines, Projection of the joining of two points on a line.

2. The plane: Definition, Derivation of the general equation of a plane, Different forms of the equation of plane, Angle between two planes, Bisecting plane, Combined equation of two planes, Projection on a plane.
3. Straight line: Definition, The equation of a line, Symmetrical form of equation, Condition for a line to lie in a plane, Plane through a given line, Foot of perpendicular from a point to a line, Projection of a line on a plane, Coplanar line, Line intersecting two given lines, Distance of a point from a line, Intersection of three planes.
4. Shortest distance: Definition, The derivation of shortest distance between two given lines and also the equation of shortest distance, The coplanar condition and related problems.
5. Sphere: Definition, various forms of the equation of a sphere, Plane section of a sphere, Tangent plane of a sphere, Polar plane, Orthogonal intersection of two spheres, Radical plane and Coaxial sphere.
6. Cone and cylinder: Definition, The general equation of cone, Condition of tangency, Cone with vertex at origin, Tangent plane, Angle between the lines of section, Three mutually perpendicular generators.
7. The general equation of second degree: Centre of the surface, Discriminating cubic, Nature of the conicoid, Elliptic or hyperbolic paraboloid, Elliptic or hyperbolic cylinder, Pair of planes, Ellipsoid, hyperboloid or paraboloid of revolution, Parabolic cylinder or pair of parallel planes.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Bell, J. T : A Treatise on Three dimensional Geometry
2. Loney S. L. : Analytic Coordinate Geometry
3. Smith, C : An Elementary Trealises on Solid Geometry
4. B. D. Sharma : Solid Geometry 5. M. L. Khanna : Solid Geometry

2.2.3 MAT 1231 : Integral Calculus

Course Code	MAT 1231	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Integral calculus is a method for calculating the cumulative change (sum of changes) over a given time by accumulating known changes. Integral calculus is a branch of calculus that deals with integral theory and applications. Integral calculus deals with absolute scale or value, such as distances, fields, and quantities, whereas differential calculus focuses on rates of change, such as slopes of tangent lines and velocities.
Objective:

Course Outcomes (COs): By the end of the course student will be able to

CO1	Demonstrate the ability to solve infinite integrals in different standard forms.
CO2	Apply different techniques of integration to solve problems including special trigonometric and rational fractions
CO3	State the fundamental theorem of calculus and their properties. Apply the reduction formula to solve integration.

CO4 Define and evaluate the definite integral, then use it to find the summation of series.
CO5 Apply definite integral to find arc length, area, and volume from various geometrical and graphical shapes
CO6 Define Improper Integrals and solve solve Infinite Series problems. State and apply the Gamma and Beta function.
CO7 Determine properties of conic sections in algebraic, polar, and other parametric forms. Arc lengths, surface regions, and tangent to the polar curve Area and arc length in polar coordinates will be illustrated, as well as an understanding of applications of complex problems.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 1231 : Integral Calculus

Sl No	**Course Content**	Hrs	COs
1	Indefinite integral: Definition and fundamental properties, Standard form of integration	5	CO1
2	Techniques of integration: Method of substitution, Integration by parts, Special trigonometric function and rational fraction.	5	CO2
3	Fundamental theorem of calculus. Basic properties of integration. Reduction formulae, Integration by reduction.	5	CO3
4	Definite integral: Definition, General Properties of definite integral, Evaluation of definite integral, Summation of series by definite integral.	5	CO4
5	Application of integration: Plane area, Solids of revolution. Volume by cylindrical shell. Volume by cross-section. Arc length and surface of revolution	5	CO5
6	Infinite or Improper Integrals and Integration of Infinite Series, Gamma and Beta function.	5	CO6
7	Graphing in polar coordinates. Tangent to polar curve. Area and arc length in polar coordinate.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Das and Mukherjee : Integral Calculus 2. Howard Anton : Calculus 3. F. Ayres : Calculus
4. G. B. Topmas and R. L. Finny : Calculus and analytical Geometry
5. S.K.Stein and A.Barcellos : Calculus and analytical Geometry 6. M. R. Spigel : Advanced Calculus
7. Williamson : Integral Calculus

2.2.4 PHY 1241 : Mechanics, Properties of Matter, Wave & Sound

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Vector Analysis: Vector and Scalar, Addition and multiplication of vectors, triple scalar and vector product, derivative of vector. Gradient, divergence, and curl their physical significance.
2. Conservation of Energy and Linear Momentum: Conservative and non-conservative force and system, conservation of energy and momentum, Center of mass, collision problem.
3. Rotational Motion: Rotational variable, rotation with constant angular acceleration, torque on a particle, angular moment of inertia, combined translational and rotational motion of rigid body, conservation of angular momentum.
4. Oscillatory Motion: Hook's law and vibration, simple harmonic motion, combination of harmonic motion, damped harmonic motion, forced oscillation and resonance.
5. Gravitation: Center of gravity of extended bodies, gravitational field and potential their calculation, determination of gravitational constant and gravity, compound and Kater's pendulum, motion of planets and satellite, escape velocity.
6. Surface Tension: Surface tension as a molecular phenomenon, surface tension and surface energy, capillary rise or fall of liquid, pressure on a curved membrane due to surface tension, determination of surface tension of water, mercury and soap solution, effect of temperature.
7. Elasticity: (a) Moduli of elasticity, Poisson's ratio, relation between elastic constant and their determination, cantilever, flat spiral spring. (b) Fluid Dynamics: Viscosity and coefficient of viscosity poiseuille's equation, determination of the coefficient of viscosity of liquid by Stock's method, Bernoulli's theorem and its applications, Torrcelli's theorem, venturimeter.
8. Wave in Elastic Media: Mechanical wave, types of wave, Superposition principle, wave velocity, power and intensity in wave motion, interference of wave, complex wave, Standing wave and resonance. Sound Wave: Audible, Ultrasonic, and infrasonic, wave, propagation and speed of longitudinal wave, vibrating system and source of sound, beat, Doppler Elect.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. Halliday and Resnick : Physics (1 and 2)
2. Bandopadhya and Ghose : Padartha Bidya (Bengali)
3. Emran, et. al. : General Properties of Matter
4. Ahmed and Nath : Mechanics properties of Matter
5. Emran : Text Book of Sound
6. Saha : Text Book of Sound
9. Williamson : Integral Calculus

2.2.5 ENG 1251 : Functional English

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Grammar: Parts of Speech, sentence, appropriate preposition, tense, use of voice, phrase & clause, conditional sentences, infinitive, participle & gerunds, correction of sentence.
2. Developing vocabulary: suffixes, prefixes, synonyms and antonyms, conversion of words.
3. Situational writing: press releases, resume/curriculum vitae, paragraph writing, composition/essay.
4. Spoken English: Introduction to phonetic symbols, dialogue, responding to particular situations, presentations.
5. Translation: Translation from Bengali to English and English to Bengali.
6. Scientific writing for experiments and projects: Distinctive features of scientific writing (figures, tables, equations, captions numbering, title and section headings), professional research reporting.
7. Reading : reading strategies(scanning and skiming), paraphrasing and summarising, reading of selected texts, thematic writing.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks. Seven questions of equal value will be set, of which five are to be answered.

Recommended Books: 1. Swales, J : Writing Scientific English
2. Hornby, As :The Teaching of Structural Words and Sentence Patterns (stages 1&2), (stages)
3. Ahmed, S : Learning English Grammar
4. Thomson, AJ and Martinet, AV : A Practical English Grammar
5. Maugham, WS : The Lotus Eater
6. Desai, A: Games at Twilight
7. Richards, JC and Rogers, TS: Approaches and Methods in Language Teaching
8. Roach, PJ: English Phonetics and Phonology

2.2.6 STA 1261 : Probability and Probability Distribution

Course Code	STA 1261	CIE Marks	30
Credits	02	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: This course is designed to provide fundamental concepts of probability and practices different discrete and Continuous Probability Distribution.

Objective: Understand the meaning of probability and probability distribution.
Introduced new techniques for carrying out probability calculations and identifying probability distributions.
Formulate and evaluate the problems associated with probability distribution.

Course Outcomes (COs): By the end of the course student will be able to

CO1	Identify the role of probability that can play in any field of problem-solving process.
CO2	Calculate and interpret probability of any given event.
CO3	Understand underlying concept of random variable and their usage.
CO4	Understand the meaning of mathematical expectation and use this to find mean, variance, moments, correlation coefficient of random variables.
CO5	Use Chebyshev's inequality to compute the probability of a random variable.
CO6	Calculate Moment generating function, characteristic function and probability generating function of a random variable.
CO7	Use probability distribution in different practical situation as well as find different properties of the distribution.

Contact Hr/Week: 2.0 **(Credit : 2.0)**

Mathematics code and Title

Sl No	**Course Content**	Hrs	COs
1	Basic Concept of Probability: Sample Space, Event, Event Space and Different Types of Events, Classical, Empirical, Geometric, Relative Frequency and Axiomatic Methods of Probability,	3	CO1
	Odds Ratio, Probability Measures and Probability Space, Total Probability, Tree Diagrams and Compound Probability, Conditional Probability, Prior and Posterior Probability, Bayes Theorem, Central Limit Theorem.	2	CO2
2	Random Variable: Concept of Random Variable, Discrete and Continuous Random Variables, Probability Function, Distribution Function, Function of Random Variable and its Distribution, Joint, Marginal and Conditional Distribution, Independence of Random Variables.	5	CO3
3	Expectation: Meaning of Expectation and Conditional Expectation, Mean, Expectation of a Function of a Random Variable, Variance, Conditional Mean and Conditional Variance, Moments,	3	CO4
	Covariance and Correlation Coefficient, Expectation of Sum and Product of Random Variables, Chebyshev's Inequality	2	CO5
4	Generating Function: Moment Generating Function, Characteristic Function, Probability Generating Function, Cumulant Generating Function and Their Properties, Inversion Theorem, Convolution.	5	CO6
5	Probability Distribution: Bernoulli, Binomial, Poison, Exponential, Uniform, Normal distribution and Bivariate Normal distribution.	5	CO7

Text Books:

1. Hogg R V & Craig A T: Introduction to Mathematical Statistics.
2. Mood, Graybill & Boes : Introduction to the Theory of Statistics.

Recommended References and Books:

1. Roy, M.K.: Probability and Probability Distribution.
2. Ross S M: A first Course in Probability.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final Examination: 70 marks. Exam Duration: 3 hours. Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation				
Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination	
Bloom's Category	Semester Final Examination Marks (70)
Remember	15
Understand	15
Apply	10
Analyze	20
Evaluate	10
Create	-
Total	70

2.2.7 CSE 1262 : Structured Programming Lab Using C++

Contact Hr/Week: 4.0 **(Credit : 2.0)**

Course Content

Lab of this course shall be based on programming with Object Oriented Concept (Involving Class, Object, Member Functions, etc).
1. Determination the value of any functions in the form of $y = f(x), y = f(x_1, x_2, \ldots x_n)$. Solution of quadratic equation using if else statement, switch statement.
2. Area and perimeter of circle, triangle, quadrangle. Surface area and volume of sphare, cone, cube, prism, etc.
3. Sum of first n-natural number, prime number. Sum of series: $sin(x)$, $cos(x)$, $tan(x)$, $log(x)$, and e^x.
4. Prime number, factorial of a number and Fibonacci number.
5. One dimensional array: Sorting, searching, highest and lowest value, mean, variance
6. Calculation of interest rate, income tax, annuity, telephone bill, electric bill and grading system.
7. Matrix operation addition, subtraction, scalar multiplication, matrix multiplication, determinant of a matrix, inverse matrix and eigenvalue.
8. Creation of Class that involves various objects and functions based on mathematical operations.
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (4 hours) Examination of laboratory course: 50 marks.

Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. E Balagurusamy : Object Oriented Programming with C++
2. John R Hubbard : Schaum's outline series: Programming with C++
3. Joyce Farrell : Object Oriented Programming using C++
4. Herbert Schildt : Teach yourself C++

2.2.8 MAT 1280 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.

A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.3 2nd year 1st semester

2.3.1 MAT 2111 : Theory of Matrices

Contact Hr/Week: 2.0 **(Credit : 2.0)**

Course Content

Matrix Algebra:
1. Matrix: Definition, Different types of matrices and their properties. 2. Adjoint, inverse, block matrix with properties. Theory and properties of determinant, higher order determinant, solution of system of equations by determinant. 3. Matrix Decomposition or matrix factorization: LU, Rank factorization, Cholesky decomposition, QR decomposition,Schur decomposition,QZ decomposition, Singular value decomposition. 4. Elementary transformation, ranks of a matrix, echelon, canonical and normal form, rank of a matrix. 5. System of linear equations, solution of homogenous and non-homogenous system by Matrix method and reduction to equivalent system. 6. Eigen value, Eigen vector, Cayley-Hamilton theorem and its application, Matrix Diagonalization. 7. Bilinear and Hermitian form. Quadratic form, Definite and semi-definite forms of Matrices. Generalized Inverse/ G-Inverse.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. M. L. Khanna : Matrices
2. F. Ayres : Theory of Matrices
3. C. C. Mcduffe : Theory of Matrices

2.3.2 MAT 2121: Linear Algebra

Contact Hr/Week: 2.0 **(Credit : 2.0)**

Course Content

Linear Algebra: 1. Vector Space and Sub Space. 2. Linear Combination, Linear dependence and independence. 3. Generators, Basis and Dimension. 4. Linear transformation. 5. Matrix representation of a linear operator. Change of basis, Similarity, Matrices and Linear mapping. 6. Linear functional and Dual vector spaces, Annihilators. 7. Inner Product Spaces. 8. Bilinear, Quadratic and Hermition forms 9. Orthogonalization.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Lipschutz, S : Linear Algebra
2. Hamilton, A.G. : Linear Algebra
3. Hardly, G. : Linear Algebra
4. Anton, H. & Rorres, C. : Elementary Linear Algebra

2.3.3 MAT 2131: Advanced Calculus

Course Code	MAT 2131	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: The interpretation of the rate of change of one quantity with respect to another quantity, as well as finding the area, are fundamental problems in the branch of mathematics known as Calculus. This course is intended to teach the concepts of Differential Calculus and Integral Calculus, as well as the method for solving various mathematical problems.
Objective: The objective of the course is to teach Differential Calculus and Integral Calculus, as well as the methods for solving various mathematical problems involving functions of two and three variables .
Course Outcomes (COs): By the end of the course student will be able to

CO1	Find Jacobian and Hession of continuous function and use them in mathematical problems and Express Euler's theorem for homogeneous functions.
CO2	Determine the maximum and minimum values of different functions and apply the concept to real life problems.
CO3	Apply the powerful method for maximizing or minimizing a function subject to constraints on several variables.
CO4	Identify and sketch different types of graphs and analyse the graphs at different critical points and locations.
CO5	Explain the various types of improper integrals and how they are used.
CO6	Define multiple integrals and apply them to find the arc length, area, volume.
CO7	Define and apply double and triple integration as well as explain iterated integrals. State and implement Diritchlet's Theorem.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 2131 Advanced Calculus

Sl No	**Course Content**	Hrs	COs
1	Function of several variables: Partial differentiation, total differentiation, differentials, Euler's theorem of homogeneous function, Taylor's series for function of several variables, Jacobian, Heissen matrix.	6	CO1
2	Maxima and Minima of function of several variables and applications.	5	CO2
3	Curvature of plane curve, Concave and convex curve, Node, cusp, conjugate point, the point of inflexion.	6	CO3
4	Curve tracing	6	CO4
5	Definite integration: Integration under the sign of differentiation and integration, Improper integral, Theorem of Frullani, Applications of definite integral.	5	CO5
6	Determination of arc length, areas and volume using multiple integral	6	CO6
7	Multiple integral: Double integration, triple integration, Diritchlet's Theorem, Change of order of integration	6	CO7

Recommended Books:
1. M. R. Spiegel : Advanced Calculus
2. Williamson : Integral Calculus
3. Edwards J. : Differential Calculus
4. Wider : Advanced Calculus

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation

Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination

Bloom's Category	Semester Final Examination Marks (70)
Remember	10
Understand	15
Apply	25
Analyze	15
Evaluate	5
Create	-
Total	70

2.3.4 MAT 2141 : Ordinary Differential Equations

Rationale: The topic of the course is the study of ordinary differential equations. Differential equations can be used to model geometric and physical problems. It is important for mathematics students to formulate, derive mathematical models using differential equations, solve the model equations using various techniques, and finally evaluate the obtained solutions.
Objectives: The objectives of the course are to provide an understanding of the mathematical problems of ordinary differential equations and apply various techniques to solve them. **Course Outcomes (COs):** At the end of the course student will be able to

CO1	Define differential equations, order, degree, linear and non-linear DEs, Solution of DEs, Initial value and Boundary value problem. Classify and identify the different types of ODEs/DEs. State existence and uniqueness theorems of the solution of ODEs.

CO2 Implement and apply various techniques (Separable equations, equations reducible to separable equations, exact differential equations and integrating factors, Special integrating factors, homogeneous form and transformations) to solve First Order Differential Equations.

CO3 Use different techniques to solve the first order linear equations, Bernoulli's equation. Reduce order of DE with techniques of transformation.

CO4 Solve higher order linear homogeneous equation with constant coefficients, Reduce order of DEs, Discuss the applications of second order linear differential equation. Formulate the model equations by using ODEs.

CO5 Apply Method of undetermined coefficients, operator method and method of variations of parameters to solve linear nonhomogeneous equation with constant coefficients

CO6 Solve different forms of linear equation with variable coefficients: Cauchy-Euler equation, Legendre equation, Operational factoring, Exact equation.

CO7 Apply Taylor series method, Frobenius method to solve linear differential equations, and Apply different methods (Method of elimination, Euler's method, matrix method) to solve systems of linear differential equations.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 2141 : Ordinary Differential Equations

Sl No	**Course Content**	Hrs	COs
1	Origin of differential equation, Classification of differential equation and solution, construction of differential equation. Initial value problem, Boundary value problem, Basic existence and uniqueness theorem (statement & applications only)	5	CO1
2	First order equations for which exact solutions are obtainable, Separable equation and equation reducible to this form, Exact equation and integrating factor, Special integrating factor and transformation.	5	CO2
3	Trajectories, Linear equation, Bernoulli's equation.	5	CO3
4	Higher order linear homogeneous equation with constant coefficient, Reduction of order, Basic theorem, application of second order linear differential equation.	5	CO4
5	Linear non-homogeneous equation with constant coefficient's, Method of undetermined coefficient, operator method and method of variation of parameter.	5	CO5
6	Linear equation with variable coefficient: Cauchy-Euler equation, Legendre equation, Operational factoring, exact equation	5	CO6
7	Series solution of linear differential equation, Taylor series method, Frobenius method.	5	CO7
8	System of linear differential equation, Method of elimination, Euler's method, matrix method, Elimination method.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. Robert L. Borrelli and Courtney S. Coleman : Differential equations: A Modeling Perspective

2. S. L. Ross : Differential Equations 3. G. F. Simmors : Differential Equations 4. Frank Ayres : Differential Equations
5. B. D. Sharma : Differential Equations 6. M. A. Ansary : Ordinary Differential Equations
7. H. T. Piaggio : Differential equations and their applications

2.3.5 PHY 2151 : Heat,Thermodynamics and Optics

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Thermometry: Gas thermometer and their correction, measurement of low and high temperature, Platinum resistance thermometer thermocouple. 2. Kinetic Theory of gas: Kinetic theory of gas, Deduction of Boyle's, Charle's and Avogardo's Laws, determination of gas constant, mean force path. 3. Equation of state for gas: Equation of state for a perfect gas its experimental study, vander waal's equation deduction: physical significance of 'a' and 'b' defect. 4. Liquefaction of gase: Different methods of liquefaction of air nitrogen, refrigeration. 5. Thermal conduction: Thermal conductivity, Fourier's equation of heat flow thermal conductivitie of good and bad conductor. 6. Radiation: Radiation pressure, Kirchhoffs law Black body radiation, Stefan Boltzmann's wein's law Rayleigh jean's law, Planck's Quantum law. 7. First law of Thermodynamics: Internal energy, work done by expanding fluid, Specific heat of perfect gase, Ratio of Cp to Cv, Isothermal and adiabatic expansion. 8. Second law of Thermodynamics and entropy: Reversible and irreversible processes, carnot cycle, efficiency of heat engine, absolute scale of temperature Clausius and Claperon's theorem, Change of entropy in reversible and irreversible processes. Thermodynamics Potential at constant volume and pressure, Maxwell's thermodynamics relation, specific heat equation, joule Thomson effect, production of low temperature. 9. Geometrical Optics: Fermat's principle, theory of equivalent lense; Defect of image, Optical instruments, Dispersion, Rainbow. 10. Nature and propagation light: Properties of light, wave theory and Huygen's principle, theory of light. 11. Interference: Young's experiment, Biprism, Colour of thin film, Newton's ring, Michelson and Fabry-peret interferometer.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Bhuiyan and Rahman : Text Book of Heat, Thermodynamics and Radiation
2. Halliday and Resniek : Physics (I and II)
3. Saha and Srivastava : A treatise on Heat
4. Leo and Sears : Thermodynamics
5. Zemansky : Heat and Thermodynamics
6. T. Hossain : Text Book of Heat
7. Haque : Text Book of Heat Thermodynamics and Radiation
8. Din : Text Book of Optics
9. Mathur : Principles of optics
10. Mazumder : Text Book of Light
11. Sears : Optics

2.3.6 ECO 2161 : Principles of Economics

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Introduction to Economics: Definition of economices, The Scope of Economics, Why Study Economics, Microeconomics vs. Macroeconomics, The Diverse Fields of Economics, Descriptive Economics and Economic Theory, Theories and Models, Economic Policy, The Economic Problem: Scarcity and Choice.
2. Utility Analysis and Indifference Curve Analysis: Meaning of Utility, Types and Function of Utility, Consumer's Surplus, Indifference Curve and Maps, Budget Constraints Utility Maximization.
3. Demand, Supply and Market Equilibrium: Concepts of Demand, Law of Demand, Determinants of Demand, schedules of Demand Curve, Supply, The Law of Supply, Determinants of Supply, Demand and Supply Applications, Elasticity, Market Equilibrium.
4. Market Structure and Revenue: Meaning of Market,Conditions,Classification, Concepts of Tatal, Average and Marginal Revenue, Relation between AR and MR Curves, Relation between Different Revenue. 5. Measuring National Output and National Income: Gross Domestic Product (GDP), Calculating GDP, Nominal versus Real GDP, Limitations of the GDP Concept, GDP Deflator, GDP Growth Rate, GNP, NNP, NI, PI.
6. Money , Monetory System and Banking System: Barter System, Problems of Barter System, Defination of Money, Functions of Money, Importance of Money,Value of Money,Monetory System,Classification of Monetory System, Bank,Banking, Banker, Classification of bank,Central Bank. CLR, SLR, Repo, Reversrepo.
7. Fiscal Policy and monetary Policy: Definition of Fiscal policy,Types of Fiscal policies, Objectives of Fiscal policy, Major Instruments of Fiscal policy, Meaning of Monetory Policy, Types of Monetory Policy, Objectives of Monetory Policy, Major Instruments of Monetory Policy, Fiscal Policy vs. Monetory Policy.
8. Budgets and Development Planning in Bangladesh : Conceptsof Budget,Classification,Income and Expenditure of Government,Need for Planning in Bangladesh, Various Five Years Plans in Bangladesh, Development Strategies in the Five Years Plans in Bangladesh, Millenium Development Goals, SDG's Goals.
9. International Trade: Defination of trade and International Trade, Free Trade and protection, Arguments for Protection, Arguments against Protection, Form of Protection, Balance Trade, Balance of Payment,Difference between Balance Trade and Balance of Payment, Foreign Aid, Why do Donors Give Aid, Foreign Trade vs. Aid.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. Principles of Economics, Karl E. Case, Ray C. Fair, Sharon M. Oster.
2. Paul A. Samuelson & William D. Nordhaus, Economics, (18/e), Tata McGraw Hill Publishing Company ltd., 2005.
3. David C. Colander, Economics, (6/e) McGraw-Hill.

2.3.7 MAT 2172 : Object Oriented Programming Lab

Contact Hr/Week: 4.0 **(Credit : 2.0)**

Course Content

Lab of this course shall be based on programming with Object Oriented Concept (Involving Class, Object, Member Function, etc). C++ and Java Platform shall be applied for this course.
1. Determination the value of any function in the form of $y = f(x), y = f(x_1, x_2, \ldots x_n)$. Solution of quadratic equation using if else statement, switch statement.
2. Area and perimeter of circle, triangle, quadrangle. Surface area and volume of sphare, cone, cube, prism, etc.
3. Sum of first n-natural number, prime number. Sum of series: $sin(x)$, $cos(x)$, $tan(x)$, $log(x)$, and e^x.
4. Prime number, factorial of a number and Fibonacci number.
5. One dimensional array: Sorting, searching, highest and lowest value, mean, variance
6. Calculation of interest rate, income tax, annuity, telephone bill, electric bill and grading system.
7. Matrix operation: addition, subtraction, scalar multiplication, matrix multiplication, determinant of a matrix, inverse matrix and eigenvalue.
8. Creation of Class that involves various objects and functions based on mathematical operation.
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (4 hours) Examination of laboratory course: 50 marks.
Recommended Books:
1. E Balagurusamy : Object Oriented Programming with C++
2. John R Hubbard : Schaum's outline series: Programming with C++
3. Joyce Farrell : Object Oriented Programming using C++
4. Herbert Schildt : Teach yourself C++

2.3.8 MAT 2180 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.
A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.4 2nd year 2nd semester

2.4.1 MAT 2211 : Vector Calculus

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Vector: Vector and Scalar, Dot product, Cross product, Box product, Vector triple product and their applications. 2. Vector differentiation: Vector differential operator, gradient, divergence and curl. 3. Vector integration: Line integration, Surface integration, Volume integration, Green's theorem, Gauss's divergence theorem, Stoke's theorem and their applications. 4. Curvilinear co-ordinates

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. M. R. Spiegel : Vector and Tensor Analysis
2. D. C. Agarwal :Tensor Calculus & Riemannian Geometry
3. M.A. Sattar : Vector Analysis
4. C. Weatherburn : An Introduction to Riemannian Geometry and Tensor Analysis

2.4.2 MAT 2221 : Tensor Analysis

Course Code	MAT 1111	CIE Marks	30
Credits	02	SEE Marks	70
SEE Hours	02	Total Marks	100

Rationale: A tensor is an algebraic object that defines a (multilinear) relationship between sets of algebraic objects connected to a vector space. Tensors can map between vectors, scalars, and even other tensors. Tensor analysis is crucial in many areas of mathematics, physics, mechanics, electromagnetic theory, aerodynamics, geophysics, meteorology, and any of the numerous other fields where tensor methods can be used. Tensor algebra has recently become an essential component of the mathematics required of those working in engineering, science, and related fields.

Objective: The objective of the course is to introduce students to the foundations of tensor algebra and expose them to mathematical implementations of tensor analysis to handle a variety of real-world problems. Furthermore, teach students the core principles that will act as the basis for the general theory of relativity and cosmology.

Course Outcomes (COs): At the end of the course student will be able to

CO1	Describe Einstein summation notation and Tensor, as well as their various properties; and distinguish between tensor and vector.
CO2	Use tensor algebra to perform addition, subtraction, and multiplication. Mention and apply tensor properties such as contraction, symmetric, and skew-symmetric tensors.
CO3	Express and apply metric tensor and find Conjugate and associated tensors.

CO4 Express the gradient, divergence, and curl in Tensor form. Determine the tensor's covariant and intrinsic derivatives.
CO5 Describe and apply the Riemann Christoffel tensor, the Curvature tensor, the Ricci tensor, the Bianchi identity, Flat space, and Einstein space.

Contact Hr/Week: 2.0 **(Credit : 2.0)**

MAT 2221 : Tensor Analysis

Sl No	**Course Content**	Hrs	COs
1	Tensor and Co-ordinate transformation. Covariant and contravariant vector, Mixed & invariant tensor, Addition, subtraction and multiplication of tensor, contraction, symmetric and skew- symmetric tensor, Quotient Law.	5	CO1
2	Line element and metric tensor. Conjugate and associated tensor. Christoffel's symbol and their transformation law, Geodesics and Parallelism.	5	CO2
3	Covariant derivative of a tensor, Intrinsic derivative, Tensor form a gradient, divergence and curl.	8	CO3, CO4
4	Riemann Christoffel tensor, Curvature tensor, Ricci tensor, Bianchi identity, Flat space, Einstein space and Applications of tensor.	5	CO5

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. B. Spain :Tensor Calculus
2. M. R. Spiegel : Vector and Tensor Analysis
3. D. C. Agarwal :Tensor Calculus & Riemannian Geometry
4. Synge & Schild :Tensor Calculus
5. M. A. Ansary : Tensor
6. C. Weatherburn : An Introduction to Riemannian Geometry and Tensor Analysis

2.4.3 MAT 2231: Real Analysis-I

Course Code	MAT 2231	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: The fundamental and advanced mathematics is dependent on our ability to solve equations, sum series, and so on. Most problems are not straightforward, and applying poor knowledge always results in incorrect results. It necessitates knowledge of so-called "analysis." The foundations for this work begin with Real Analysis, a course that develops this fundamental material in a systematic and rigorous manner in the context of real-valued functions of a real variable.
Objective: The primary objective of this course is to provide a satisfactory discussion of the key principles of analysis such as convergence, continuity, differentiation, and integration, all of which are based on precisely defined number concepts. The basic requirements for mathematics students are the need to demonstrate knowledge of the fundamental concepts of limit,

continuity, derivative, and integral. This extensive knowledge is important in and of itself, as well as as a foundation for more in-depth applications to all of the other courses of mathematics studies that are expected to be explored in this course.

Course Outcomes (COs): By the end of the course student will be able to

CO1	Explain the construction of real numbers, particularly the construction of real numbers from the construction of natural numbers, integers, rational and irrational numbers and the concept of field axioms.
CO2	Describe the concept of field axioms and outline fundamental properties of metric space.
CO3	Define various types of sequence and series; analyze their properties such as the existance of limit, convergence, divergence, as well as solve problems related to series.
CO4	Find the sum of the infinite series and use various techniques to determine series convergence and divergence.
CO5	Apply the epsilon-delta method to define limit, continuity, and solve problems involving limit and continuityusing epsilon-delta approach.
CO6	State and prove the Rolle's theorem, Darboux theorem, Mean value theorem, Generalized-Mean value theorem and Taylor's theorem, as well as apply these theorems.
CO7	Define Riemann Stieltjes integration and explore its various properties.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Mathematics code and Title

Sl No	**Course Content**	Hrs	COs
1	Real Number system: Notion of set, rational and irrational number, ordered set, field, ordered field, least upper bound and greatest lower-bound, least upper bound property. The existence theorem and its proof. Dedekind cut and Dedekind theorem. Dedekind theory equivalence to least upper bound property and its applications.	7	CO1
2	Basic Topology: Finite and infinite set, equivalence of set, countable set, uncountable set, metric space, open and closed set, perfect set.	5	CO2
3	Numerical sequence: Sequence, Subsequence, Bounded sequence, convergent sequence, Cauchy sequence, completeness of R	5	CO3
4	Series: Convergent series, Cauchy's criteria for convergent series, comparison test, Cauchy's root test Cauchy's condensation test, Ratio test, Integral test, Raabe's test, Leibnitz test.	5	CO4
5	Continuity: Continuous function and compactness, uniform continuity, discontinuity.	5	CO5
6	Differentiation: Derivative of function, Rolle's theorem, Darboux theorem, Mean value theorem, Generalized-Mean value theorem, Taylor's theorem.	5	CO6
7	The Riemann Stieltjes integration: Definition and existence of the integral, properties of the integral, Integration and differentiation.	5	CO7

Recommended Books:

1. Nisha Rani : Real Analysis

2. W. Rudin : Principles of Mathematical Analysis
3. M.H. Proter & C.B. Morey : Modern Mathematical Analysis
4. Bortle : Real Analysis
5. Royden : Mathematical Analysis
6. Apostal : Mathematical Analysis

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation

Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination

Bloom's Category	Semester Final Examination Marks (70)
Remember	10
Understand	15
Apply	25
Analyze	15
Evaluate	5
Create	-
Total	70

2.4.4 PHY 2241: Electromagnetism and Modern Physics

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Electrostatistics: Electric dipole, electric field due to a dipole, dipole on external electric field, Gauss's law and its applications. 2. Capacitor: parallel plate capacitor with dielectric, dielectric constant; energy stored in an electric field. 3. Electric Current: Electron theory of conductivity: conductor, semiconductor and insulator, superconductor, current and current density, Kirchhoffs Law and its applications. 4. Magnetism: Magnetic dipole, mutual potential energy of two small magnets: magnetic shell, energy in a magnetic field, magnetometer. 5.

Electromagnetic Induction: Faraday's experiment; Faraday's law Ampere's law, motional e.m.f. self and mutual inductance; galvanomenters-moving cell ballistic and deadbeat types. 6. Atomic Physics: Motion of electronics under electric and magnetic field, Measurement of e/m and 'e' positive sign, thermionic emission, photoelectric emission, Bohr's atom model, Atomic spectra, X-rays, Matter wave. 7. Nature physics: Basic concept and properties of the nucleus, Nuclear size, Binding energy, Radioactivity, Elementary knowledge of fission, Fusion and reactor cosmic ray. 8. Electronics: Vacuum diodes and triodes, P-type and n-types, semi-conductor, P-n junction, Transistor biasing, Transistor amplifier, Transmitter and receiver.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Halliday and Resnic : Physics (I and II)
2. Acharyya : Electricity and Magnetism
3. Adans and page : Principles of Electricity
4. Bandopadhyys : Padarthavidya(Bengali). Constant & GhoseTheoretical Physics
5. Din : Electricity and Magnetism
6. Emran, et al : Text Book of Magnetism, ricity and Modern Physics
7. Bandopadhya & Ghose : Padarlhavidya (Bengali)
8. Hossain T : Text Book of Heat
9. Haque : Text Book of Heat Thermodynamics and Radiation
10. V. K. Mehta : Principles of Electronics
11. Beiser : Concepts of Modern Physics
12. N. Suabrahmanyam and Brijlal : Atomic and Nuclear Physics

2.4.5 PHY 2242 : Physics Lab

Contact Hr/Week: 2.0 **(Credit : 1.0)**

Course Content

Lab Course study shall be based on related theory course.
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (4 hours) Examination: 50 marks.
Seven questions of equal value will be set, of which five are to be answered.

2.4.6 STA 2251: Mathematical Statistics

Course Code	STA 2251	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: This lesson is designed to teach fundamental concepts of statistical inference and carry out different concepts of multivariate terms, techniques, structure of real life data and its application to advanced research.
Objective: Introduced to basic idea about statistical inference for concluding different Mathematical problems.
Capable of understanding different inferential theorem and their applications.
Outline the main features of multivariate data.
Course Outcomes (COs): At the end of the course student will be able to

CO1	Narrate the fundamental concepts of inference.
CO2	Describe various feature of point estimator and its requirements in real life.
CO3	Demonstrate the understanding the basic concept of statistical hypothesis.
CO4	Conceptualize the basic idea of organization, display of multivariate data.
CO5	Test for multivariate normality of the data.
CO6	Perform data reduction using principal component analysis (PCA).
CO7	Display a widespread accepting of factor, testing factor model, factor interpretation and data reduction.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Estimation: Concept of Estimation, Point estimation. Characteristic of a good point estimator, methods of point estimation. Concept of interval estimation. Methods of interval estimation. Interval estimation of mean and variance of normal distribution, MLE.
2. Hypothesis Testing: Basic Concept of Hypothesis, Type I and Type II Error, Level of Significance, P- value, Power of a Test. Detail Study of λ^2, t & F Distributions, Test of significance in small and large samples. Comparison of means, proportions and variance. Test of homogeneity of variances, Test for r x c contingency table.
3. Multivariate Analysis: Meaning and Application of Multivariate Analysis.
4. Multivariate Normal Distribution: Meaning and form of Multivariate Normal. Properties of Multivariate Normal Distribution, Maximum Likelihood Estimator of Mean Vector and Variance Covariance Matrix and its Properties.
5. Multivariate Sampling Distributions: The Distribution of Hotelling's T2, D2 and their Properties. 6. General Linear Regression Model: Meaning, Functional form and Underlying Assumptions. Estimation of Parameter with its mean and Variance.
7. Principal Component Analysis: Introduction to the Principal Component Analysis, ML Estimator of the Principal Components and their Variances, Sampling Properties of the Sample Principal Components, Statistical Inference.
8. Factor Analysis: Definition and Purpose of Factor Analysis, Mathematical Model for Factor Structure, ML Estimators for Random Orthogonal Factors, Estimation for Fixed Factors, Factor rotation. Testing the Goodness of Fit of the Factor Model.

STA 2251 Mathematical Statistics

Sl No	**Course Content**	Hrs	COs
1	Estimation: Concept of Estimation, Point estimation. Characteristic of a good point estimator, methods of point estimation. Concept of interval estimation. Methods of interval estimation. Interval estimation of mean and variance of normal distribution, MLE.	6	CO1 CO2
2	Hypothesis Testing: Basic Concept of Hypothesis, Type I and Type II Error, Level of Significance, P- value, Power of a Test. Detail Study of λ^2, t & F Distributions, Test of significance in small and large samples. Comparison of means, proportions and variance. Test of homogeneity of variances, Test for r x c contingency table.	6	CO3
3	Multivariate Analysis: Meaning and Application of Multivariate Analysis.	4	CO4
4	Multivariate Normal Distribution: Meaning and form of Multivariate Normal. Properties of Multivariate Normal Distribution, Maximum Likelihood Estimator of Mean Vector and Variance Covariance Matrix and its Properties. Multivariate Sampling Distributions: The Distribution of Hotelling's T2, D2 and their Properties. General Linear Regression Model: Meaning, Functional form and Underlying Assumptions. Estimation of Parameter with its mean and Variance.	6	CO5
5	Principal Component Analysis: Introduction to the Principal Component Analysis, ML Estimator of the Principal Components and their Variances, Sampling Properties of the Sample Principal Components, Statistical Inference.	6	CO6
6	Factor Analysis: Definition and Purpose of Factor Analysis, Mathematical Model for Factor Structure, ML Estimators for Random Orthogonal Factors, Estimation for Fixed Factors, Factor rotation. Testing the Goodness of Fit of the Factor Model.	6	CO7

Text Books:

1. Johnson, R. A. and Wichern, D. W. (2007): Applied Multivariate Statistical Analysis, 6th Edition, Pearson Education, Asia.

2. Mood, A.M., F. A. Graybill and D.C. Boes (1994): Introduction to the theory of Statistics. 5th ed., McGraw-Hill, N.Y

Recommended References and Books:

1. Anderson, R. A. and D. W Wichern (2002): An Introduction to Multivariate Statistical Analysis, 5th ed., Wiley, N.Y

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final Examination: 70 marks. Exam Duration: 3 hours. Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation				
Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (30)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	5	-	10	15
Analyze	-	5	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination	
Bloom's Category	Semester Final Examination Marks (70)
Remember	10
Understand	20
Apply	15
Analyze	15
Evaluate	10
Create	-
Total	70

2.4.7 STA 2252 : Statistical package Lab (R/SAS/STATA/Eviews)

Course Code	STA 2252	CIE Marks	50
Credits	02	SEE Marks	50
SEE Hours	04	Total Marks	100

Rationale: This course will expose students to different mathematical packages as well as data processing and analysis of these packages.
Objective: The objective of the course is to introduce various statistical packages and use them to process, summarize, and analyze data, as well as explain the results.
Course Outcomes (COs): By the end of the course student will be able to

CO1	Demonstrate the layout and interface of statistical packages.
CO2	Use statistical package to perform statistical analyses in for continuous and categorical variables (descriptive statistics, t-tests, correlation, linear regression etc).
CO3	Produce different graphical representations of data using statistical package.
CO4	Perform ANOVA and make valid inference for different model.
CO5	Forecast time series data.

Contact Hr/Week: 4.0 **(Credit : 2.0)**

STA 2252 Statistical package Lab

Sl No	**Course Content**	Hrs	COs
1	Computation of various measures of central tendency, dispersion, range, standard deviation, mean deviation, first four moments, skewness and kurtosis from ungrouped data.	6	CO1
	Correlation and regression for two variables. Probability Distribution: Fitting of Binomial, Poisson exponential and Normal Distribution. Matrix Algebra: Transpose, Addition, Subtraction, Multiplication and Inversion.	6	CO2
2	Graph: Graphical presentation by using group and ungroup data.	4	CO3
3	Analysis of Variance: One-way classification.	6	CO4
4	Time series analysis: Check stationary and non-stationary data, components of time series.	6	CO5

Text Books:
1. Paul Teetor- R Cookbook.

Evaluation: Class attendance: 10 marks, Continuous assessment: 50 marks, Semester Final Examination: 50 marks. Exam Duration: 4 hours. Seven questions of equal value will be set, of which five are to be answered.

Assessment Pattern

CIE- Continuous Internal Evaluation

Bloom's Category	Test/Quizzes	Assignment	Active Participation in Class External Participation in Curricular Co-Curricular Activities	Total (50)
Remember	5	-	-	5
Understand	5	-	-	5
Apply	20	-	10	30
Analyze	5	5	-	10
Evaluate	-	-	-	-
Create	-	-	-	-

SEE-Semester End Examination

Bloom's Category	Semester Final Examination Marks (70)
Remember	-
Understand	10
Apply	10
Analyze	20
Evaluate	10
Create	-
Total	50

2.4.8 ACT 2261: Accounting, Business and Entrepreneurship

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

Accounting Principles: Accounting Fundamentals, Accounting in perspective of Software Industries, Transaction Analysis, Accounting Cycle, Principles of Journal Entries, Ledger, Trial Balance, and Adjusting Entries.
Financial Statement: Income statement, Cash flow statement, Balance sheet, Analysis of Financial Statements for Software Industries, Ratio Analysis.
Managerial and Cost Accounting: Cost concepts; Cost of Goods Manufactured Statement
Cost-Volume-Profit analysis: meaning breakeven analysis, contribution margin approach, sensitivity analysis, Costing for Decision making and reporting, Flexible budget and standard costing, Overhead cost: meaning and classification; Distribution; Job order costing: preparation of job cost sheet and quotation price; Inventory valuation.
Entrepreneurship: Introduction to Entrepreneurship, Forms of Entrepreneurship, Social responsibility and Entrepreneurship Ethics, Entrepreneurship Law and Government.
Business Plan: Target Market, The Competition, Risk Assessment, Technology Plan, Exit Plan, Cash-Flow Projection, SWOT(Strengths/Weaknesses/Opportunities/Threats), covered in this course.
Valuation: Importance of company valuation, earning, growth, growth rate, different model of valuations: Asset valuation, Historic earning valuation, Relative valuation, Future earnings valuation, Discount cash flow model, Dividend discount model, Free cash flow model, WACC, Residual earning model.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Management, Harold Koontz, McGraw-Hill.
2. Account Principle, Weygandt,Kieso & Kimmel, John Wiley & Sons, Inc.
3. Entrepreneurship Development, Nazrul Islam and Muhammad Z Mamun, The University Press Limited.
4. Entrepreneurship Development, An Indo-German Technical Cooperation Project.
5. Wild, Larson, Chiappetta, Financial and Managerial Accounting, (Latest edition).
6. R.H Hermanson, J. D. Edwards and L.G. Rayburn, Financial Accounting, (Latest edition), Business Publication.Inc. Dallas.
7. R.H Hermanson, J. D. Edwards and L.G. Rayburn, Financial Accounting, (Latest edition), Business Publication.Inc. Dallas.

2.4.9 MAT 2270 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content
Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.
A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.5 3rd year 1st semester

2.5.1 MAT 3111 : Real Analysis-II

Course Code	MAT 3111	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Real analysis in mathematics is the branch of mathematics that explores the action of real numbers, sequences and series of real numbers, and real functions. Convergence, boundaries, consistency, smoothness, differentiability, and integrability are some of the specific properties of real-valued sequences and functions studied by real analysis. **Objective:** The purpose is to extend the student's understanding of core mathematical analysis and the calculus. **Course Outcomes (COs):** By the end of the course student will be able to

CO1	Define and demonstrate understanding with examples of Neighborhood at a point, open and closed set, limit point, cluster point, closure, interior and boundary point
CO2	Define, Discuss, state and prove related theorems as well as solve problems involving compact and connected sets.
CO3	Define the properties of Metric space and the various types of norm space. State the properties of Cauchy Schwarz and MinKowski's inequality and use it to prove various propositions.
CO4	Define sequences and series of functions, state various properties, and solve problems involving uniform convergence and continuity, uniform convergence , integration and differentiation. The Stone-Weierstrass Theorem should be stated and applied.
CO5	Define the function of multiple variables, as well as the limit and continuation of two variables, differentiation, and partial differentiation. State and demonstrate Schwarz's and Young's theorems.
CO6	Define and illustrate Linear Transformation and Differentials. State and apply the Inverse Function Theorem, the Implicit Function Theorem, the Rank Theorem, and the contraction mapping Theorem. Determine the Jacobian of a function.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3111 and Real Analysis-II

Sl No	**Course Content**	Hrs	COs
1	Topology and Real number: Neighborhood at a point, open and closed set, limit point, cluster point, closure, interior and boundary point.	5	CO1
2	Compact Set: Compact set, locally compact set, K cell, and related theorems, perfect set, Continuity and compactness.	5	CO2
3	Connected Set: Connected set, locally connected set, path wise connected set and related theorems, Cantor set, continuity and connected set	5	CO2

4	Metric Space: Definition, Metric space, norm, norm space, Euclidean norm, Cauchy Schwarz inequality, and MinKowski,s inequality.	5	CO3
5	Sequence and Series of Function: Discussion about their properties and problems, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation, The Stone-Weierstrass Theorem.	5	CO4
6	Function of Several Variables: Limit and continuity of two variables, Differentiation, Partial differentiation, Schwarz's theorem & Young's theorem.	5	CO5
7	Linear Transformation, Differentials, The Inverse Function theorem, The Implicit Function theorem, The Rank theorem, Jacobian, The Contraction mapping theorem.	5	CO6

Recommended Books:
1. Rudin, W. : Principles of Mathematical Analysis
2. Royden : Mathematical Analysis
3. Apostol : Mathematical Analysis
4. Spiegel, M.R. : Real Variables

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final Examination: 70 marks. Exam Duration : 3 hours.
Seven questions of equal value will be set, of which five are to be answered.

2.5.2 MAT 3121: Complex Analysis

Course Code	MAT 3121	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Complex analysis is a field of mathematics that studies functions of complex numbers. It is useful in many fields of mathematics, including algebraic geometry, number theory, analytic combinatorics, and applied mathematics, as well as physics, including hydrodynamics, thermodynamics, and, in particular, quantum mechanics. Complex research is also used in engineering areas such as chemical, automotive, electronic, and electrical engineering.
Objective: The objective of this course is to introduce the fundamental ideas of complex variable functions as well as to gain a good understanding of the fundamental principles of Complex Analysis such as analytic functions, complex integrals, and a set of skills that will enable students to work efficiently with the concepts.
Course Outcomes (COs): By the end of the course student will be able to

CO1	Demonstrate comprehension of the complex number system by defining Singularity, Riemann Surface, Limit, and Complex Function Continuity.
CO2	Define Analytic function with examples. Derive derivation, Cauchy Riemann equation, orthogonal family of curves, harmonic function and solve related problems.
CO3	Define complex integration; state, and prove Cauchy's theorem, the Fundamental theorem of algebra, and Rouche's theorem. Use Cauchy's integral formulae, the maximum modulus theorem, and similar problems to solve problems.
CO4	Define Infinite Series of function and power series. State Taylor's theorem, Laurent's theorem and list analytic continuations. Resolve related problems.

CO5 Define Residue and state Residue theorem. Evaluate definite integral.
CO6 Discuss and apply conformal mapping. Use various transformation such as general transformations, linear transformation, Bilinear Transformation.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3121 Complex Analysis

Sl No	**Course Content**	Hrs	COs
1	Complex number system: Complex number, polar form of complex number, complex plane, point set.	5	CO1
	Complex Function: Single and many valued function, Singularity, Riemann Surface, Limit and continuity.	5	CO1
2	Analytic function: Derivation, Cauchy Riemann equation, orthogonal family of curves, harmonic function.	5	CO2
3	Complex integration: Cauchy's theorem, some consequences of Cauchy's theorem and applications.	5	CO3
	Complex integration and related theorem: Cauchy,s integral formulae, maximum modulus theorem, Fundamental theorem of algebra, Rouche's theorem, Argument principle.	5	CO3
4	Infinite series: Series of function, power series, Taylor's theorem, Laurent's theorem, analytic continuation.	5	CO4
5	Calculation of Residue: Residue, Residue theorem, Evaluation of Definite integral.	5	CO5
6	Conformal mapping: Some general transformations, linear transformation, Bilinear Transformation, Applications of the conformal mapping.	5	CO6

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:

1. B. S. Taygi : Complex Variable
2. M. R. Spiegel : Complex Variable
3. J. B. Conway : Functions of complex variables
4. L. V. : Complex Analysis
5. D. Sarason : Notes on complex function theory
6. M. L. Khanna : Complex Analysis

2.5.3 MAT 3131 : Mechanics

Course Code	MAT 3131	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Mechanics is a branch of physics that studies the movements of physical objects, especially the interactions between force, matter, and motion. This course will teach students the basic concepts of physics (statics and dynamics) as well as how to solve various mathematical problems. **Objective:**The objective of the course is to provide the fundamental concept of mechanics (statics and dynamics) and know the solution procedure of different mathematical problems.

Course Outcomes (COs): By the end of the course student will be able to

CO1	1 Describe the reduction of coplanar forces, their equilibrium, the resultant force, the general state of equilibrium, the resultant equation, a static equilibrium and its conditions, and a static center.
CO2	1 Distinguish between work and virtual work, describe the procedure of forming the different equations of virtual work and solution. Test nature of equilibrium a string and chain at different points of different shapes of bodies, able to find the coordinates of equilibrium. State General condition of equilibrium of string, Catenary of a uniform strength, String under central forces.
CO3	Find and locate the coordinates of centre of an arc's gravity, a plane field, a solid, a revolution's surface, and a volume.
CO4	Define simple harmonic motion, central forces, radial and transverse velocity and acceleration, apse and apsidal distance, and define displacement, motion, and acceleration of particles in various coordinate systems and three dimensions.
CO5	Discuss rigid body dynamics, moment and product of inertia, state D' Alembert's Principle, general equation of motion independence of translation and rotational motion, and empulsive force.
CO6	Discuss the holonomic and non-holonomic systems, as well as the generalized coordinate system. For holonomic and non-holonomic dynamical systems, deduce Lagrange's equation.
CO7	State Elementary Principle, Describe Mechanics of a particle and a system of particles, constraint, D-Alembert's theorem, and Reduce Lagrange's equation. Apply Lagrange's equation to solve related problems.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3131 Mechanics

Sl No	**Course Content**	Hrs	COs
1	Statics: Equilibrium of coplanar force, A static equilibrium, Stable and unstable equilibrium, General conditions of equilibrium forces.	3	CO1
2	Principle of virtual work, Stable and unstable equilibrium. Equilibrium of a string and chain: The common catenary, General condition of equilibrium of string, Catenary of a uniform strength, String under central forces.	3 3	CO2 CO2

3	Centre of gravity: (i) Centre of gravity of an arc (ii) Centre of gravity of a plane area (iii) Centre of gravity of a solid and surface of revolution (iv) Centre of gravity of any volume.	5	CO3
4	Motion in a straight line, Simple harmonic motion. Motion in a plane referred to a Cartesian and polar co-ordinates, Central forces, Radial and transverse velocity and acceleration, Apse and apsidal distance. Motion in three dimensions, Acceleration in terms of polar and Cartesian co-ordinates.	2 3 2	CO4 CO4 CO4
5	Dynamics of a rigid body: a) Moment and products of inertia: The momental Ellipsoid, Equi-momental systems, principal axes. b) D' Alembert's Principle: The general equation of motion, Independence of the motion of translation and rotation, Empulsive force.	5	CO5
6	Generalized coordinate: Holonomic and 6on-holonomic system. lagrange's equation for holonomic and non-holonomic dynamical systems.	5	CO6
7	Elementary Principle: Mechanics of a particle and system of particle, constraint, D-Alembert's principle and lagrange's equation. Simple application of lagrange's equation.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. S. L. Loney : An Elementary treatise on the dynamic of a particle and of Rigid Bodies
2. S. L. Loney : An Elementary treatise on statics
3. A. S. Ramsey: Dynamics 4. P. P. Gupta : Statics
5. G. S. Malik : Dynamics

2.5.4 MAT 3141 : Partial Differential Equation

Course Code	MAT 3141	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Partial differential equations are used to formulate mathematically and also to help solve physical or other problems concerning the various vector functions such as heat or sound propagation, air flow, elasticity, electrostatics, electrodynamics, etc.

Objective: This course is intended to teach the basic principle of differential equations as well as the method for solving various mathematical problems concerning these forms of equations.

Course Outcomes (COs): By the end of the course student will be able to

CO1	Formulate different order Partial Differential Equations
CO2	Derive PDEs to the form of $Pdx + Qdy + Rdz = 0$ and $dx/P = dy/Q = dz/R$ and solve them
CO3	Derive, Identify and solve first-order quasilinear and non-linear PDEs
CO4	Classify second order PDEs and Transform to its canonical form.
CO5	Derive and solve Second Order homogeneous and non-homogeneous PDE.
CO6	Discuss the origins and applications of parabolic, elliptic, hyperbolic PDEs and be able to solve them.

CO7	Convert a Laplace's equation to Cartesian, Cylindrical and Spherical coordinate system. Solve the diffusion (heat flow) and wave equations.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3141 and Partial Differential Equations

Sl No	**Course Content**	Hrs	COs
1	Formation of PDE and First order linear PDE.	5	CO1
2	Total Differential Equation: Integrability condition, Solution method for $Pdx + Qdy + Rdz = 0$ and $dx/P = dy/Q = dz/R$	5	CO2
3	First Order quasilinear and non-linear PDE.	5	CO3
4	Classification of general second order PDE and canonical form.	5	CO4
5	Second Order homogeneous and non-homogeneous PDE.	5	CO5
6	Second Order non-linear PDE, Parabolic form, Elliptic form, Hyperbolic form.	5	CO6
7	Solution of Laplace's equation in Cartesian, Cylindrical and Spherical coordinate. Solution of diffusion (heat flow) equation. Solution of wave equation	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. F. Ayres : Differential Equations 2. B.D. Sharma : Partial Differential Equations
3. I.N. Sneddon : Elements of partial Differential Equations
4. R. Dennemeyer : Introduction to partial Differential Equations
5. T Myint U : Partial Differential Equations

2.5.5 MAT 3151 : Mathematical Method-I

Course Code	MAT 3151	CIE Marks	30
Credits	02	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Mathematical Methods appear as differential equation solutions and integrals of special functions. As a result, this course covers the most essential integrals, or at the very least, the integral representation of special functions. Mathematical Methods is closely related to some topics of mathematical physics and symmetries of differential equations are important to both physics and mathematics.

Objective: The course's objective is to educate students how to solve ODEs and PDEs using Laplace and Fourier transforms.

Course Outcomes (COs): By the end of the course student will be able to

CO1	Define Laplace Transforms and their basic properties, conditions for Laplace Transform existence, unit-step function, error function, direct delta function, Bessel function, and so on.
CO2	Describe and recognize periodic functions, Fourier series, Fourier coefficients, sine and cosine series, Half-range Fourier series, Fourier series with even and odd functions

CO3	Reduce the Fourier sine and cosine transformations, as well as the finite and infinite Fourier transforms and the complex Fourier transform, as well as the convolution theorem.
CO4	Define the Z-transformation and use it to extend complex functions. Examine the relationship between the Fourier Series and the Z-transformation.

Contact Hr/Week: 2.0 **(Credit : 2.0)**

MAT 3151 Mathematical Method-I

Sl No	**Course Content**	Hrs	COs
1	The Laplace Transform: Definition, existence, and basic properties, Differentiation and integration, Inverse Laplace transform and convolution, Solution of linear differential equation with constant coefficient, and linear system.	6	CO1
2	Fourier series: Fourier coefficient, sine and cosine series, Diritchlet's theorem, Properties and applications.	6	CO2
3	Fourier transform: Fourier sine and cosine transform, Complex Fourier transform, convolution theorem, Application to boundary value problem, asymptotic expansion.	6	CO3
4	Z-transformation: Definition, expansion, relation between Fourier Series and Z-transformation.	5	CO4

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. D. A. Kuddus : Mathematical Methods
2. Jeffreys and Jeffreys : Methods of Mathematical Physics
3. Courant and Hilbert : Methods of Mathematical Physics 4. B.S. Rajput : Mathematical Physics
5. M R Spiezel : Laplace Transforms
6. B.D. Sharma and R.K. Gupta : Mathematical Method 7 M J Lighthill : Asymptotic Expansion
8. L A Pipes : Applied Mathematics for Engg. & Scientist

2.5.6 CSE 3161: Relational Database Management System (RDBMS)

Course Code	CSE 3161	CIE Marks	30
Credits	02	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:

Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3

CO4
CO5
CO6
CO7

Contact Hr/Week: 2.0 **(Credit : 2.0)**

Course Content

Introduction: Database-System Application, Purpose of Database System, View of Data, Database Languages, Relational Database, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information, Retrieval, Specialty Database, Database Users and Administrators. Introduction to the Relational Model: Structure of Relational Database, Database Schema, Keys, Schema, Diagrams, Relational Query Languages, Relational Operations, Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus. SQL: Overview of the SQL Query, Language, SQL Data Definition, Basic Structure of SQL, Queries, Additional Basic Operations, Set Operation, Null Values, Aggregate Function, Nested Sub-query, Join Expression, Transaction, Integrity Constraint, SQL Data Types and Schemas, Authorization, Function and Procedure, Trigger, Recursive Query, Advanced Aggregation Feature, OLAP. Database Design and the E-R Model: Overview of the Design Process, Entity-Relationship Model, Constraint, Removing Redundant Attributes in Entity Set, Entity-Relationship Diagram, Reduction to Relational Schemas, Entity-Relationship Design Issues, Extended E-R Features, Alternative Notations for Modeling, Data, Other Aspects of Database Design. Relational Database Design: Features of Good Relational Design, Atomic Domain and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, More Normal Forms, Multivalued Dependencies, Domain-Key Normal Form.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. A. Silberschatz : Database System Concepts, McGraw-Hill.
2. James Martin : Principles of Database Management, Prentice-hall Of India Pvt Ltd
3. Ullman : Database Management systems, Prentice-Hall Publication.
4. Abey : Oracle 8i a Beginners Guide, McGraw Hill.

2.5.7 CSE 3162 : RDBMS Lab (Oracle/ MySQL/SQL Server/and PL SQL)

Course Code	CSE 3162	CIE Marks	50
Credits	02	SEE Marks	50
SEE Hours	04	Total Marks	100

Rationale:

Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 4.0 **(Credit : 2.0)**

Course Content

Sessional based on CSE 3161 Relational Database Management System (RDBMS)
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (4 hours) Examination: 50 marks.
Recommended Books:
1. A. Silberschatz : Database System Concepts, McGraw-Hill.
2. James Martin : Principles of Database Management, Prentice-hall Of India Pvt Ltd
3. Ullman : Database Management systems, Prentice-Hall Publication.
4. Abey : Oracle 8i a Beginners Guide, McGraw Hill.

2.5.8 MAT 3170 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.
A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.6 3rd year 2nd semester

2.6.1 MAT 3211 : Mathematical Method - II

Course Code	MAT 3211	CIE Marks	30
Credits	02	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Mathematical Methods enhances students' knowledge of principles and techniques used to solve Bessel, Legendre, Hermite, Leguerre, and Hypergeometric equations.
Objective: The objectives of the course are to solve Bessel, Legendre, Hermite, Leguerre, Hypergeometric equations using various advanced techniques and teach students about equations' applications
Course Outcomes (COs): By the end of the course student will be able to

CO1	Identify, derive and define various terms of Bessel's Equation; find generating function and apply techniques to solve the equation
CO2	Describe the applications of Legendre's Equation, find the generating function and state its properties, and solve the equation using various techniques.
CO3	Derive and Hermite's and Leguerre's equations, as well as their differential forms, find the recurrence formula, and solve the equations.
CO4	Define and describe Hypergeometric function and its properties, as well as find its Integral formula and linear transformation
CO5	Describe the Sturm-Lioville problem, including the identification of characteristic functions and roots. Define and apply Greens function to solve the differential equations

Contact Hr/Week: 2.0 **(Credit : 2.0)**

MAT 3211 Mathematical Method-II

Sl No	Course Content	Hrs	COs
1	Bessel's Equation: Solution, Generating function, Recurrence relation, values of Bessel function, Orthogonality, Neuman, and Hankel function, Modified Bessel function.	5	CO1
2	Legendre's Equation: Solution, Generating function, Recurrence relation, Rodrigue's formula and Orghogonality of Legendre polynomial.	5	CO2
3	Hermite's Equation: Solution, Integral and Recurrence formula, Orthogonality, Differential formula. Leguerre's Equation: Solution, Integral and Recurrence formula, Differential form, Orthogonality.	5 5	CO3 CO3
4	Hypergeometric Equation: Solution, Hypergeometric function and its properties, Integral formula and linear transformation of hypergeometric function.	5	CO4
5	Sturm-Lioville problem, self-adjoint differential equation, Characteristic roots and characteristic function, Orthogonality, Greens's function.	5	CO5

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:
1. D. A. Kuddus : Mathematical Methods
2. Jeffreys and Jeffreys : Methods of Mathematical Physics
3. Courant and Hilbert : Methods of Mathematical Physics
4. B.S. Rajput : Mathematical Physics
5. M R Spiezel : Laplace Transforms
6. B.D. Sharma and R.K. Gupta : Mathematical Method
7 M J Lighthill : Asymptotic Expansion
8. L A Pipes : Applied Mathematics for Engg. & Scientist

2.6.2 MAT 3221 : Discrete Mathematics and Graph theory

Course Code	MAT 3221	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: The mathematics of modern computer science is almost exclusively based on discrete mathematics, specifically boolean algebra and graph theory. Graph theory is used extensively in operating systems to solve task management and resource utilization issues.
Objective: The course's aim is to teach teaching the necessary concepts and applications of Discrete Mathematics and Graph Theory.
Course Outcomes (COs): By the end of the course student will be able to

CO1	Define clearly the basic terminologies of graph theory.
CO2	Identify and define different kinds of path and circuit.
CO3	Define lattices and its algebraic system.
CO4	Demonstrate operations of Boolean algebra.
CO5	Apply graph theory in different in operations and other areas

.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3221 Discrete Mathematics and Graph theory

Sl No	**Course Content**	Hrs	COs
1	Graph and planar Graph: Introduction, Basic terminology, Multi-graph and weighted graph, Path and circuit, Shortest Path in weighted graph, rulerian Path and circuit, Hamiltonian Path and circuit.	7	CO1
2	Tree and Cut Set: Tree, Rooted tree, Path length in rooted tree, Binary search tree spanning tree and custset, Minimum spanning tree.	7	CO2
3	Lattice: Lattice and Algebraic system, Principle of duality, Basic Properties of Algebraic system defined by lattices, Distributive and complemented lattices, Boolean lattices and Boolean algebra.	7	CO3

4	Boolean Algebra: Boolean function and Boolean expression Propositional calculus, Design and implementation of digital Network, Switching circuit. Boolean lattice.	7	CO4
5	Basic application of graph theory: In switching and coding theory, Electrical network analysis by graph theory, graph theory in operation research	7	CO5

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. C. L Liu : Elements of Discrete Mathematics
2. Robert J. McElice : Introduction to Discrete Mathematics
3. Alan Doer : Applied discrete structure for computer Science
5. Berge, C : The theory of Graphs
6. Harary, F : Graph Theory
7. Parthasarathy, K. R : Basic Graph Theory

2.6.3 MAT 3231 : Numerical Analysis

Course Code	MAT 3231	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Numerical analysis is a branch of mathematics and computer science that develops, analyzes, and applies algorithms to solve problems with continuous variables.
Objective: To give students a thorough understanding of the principles and techniques of numerical analysis as outlined in the syllabus. Students will learn how to solve ODEs, algebraic equations, and systems of linear equations, among other things. **Course Outcomes (COs):** By the end of the course student will be able to

CO1	Use a variety of approaches to trace the roots of algebraic and transcendental equations.
CO2	Apply the finite difference scheme and various iteration approaches.
CO3	Define and describe divided difference and its properties, as well as use interpolation in the case of unequal intervals.
CO4	Find approximation missing details, use curve fitting and cubic spline.
CO5	Employ different approaches to solve a system of linear and nonlinear equations.
CO6	Use numerical methods to obtain an approximate solution to differentiation, integration, and ODE problems.
CO7	Apply different methods to solve a partial differential equations.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3231 Numerical Analysis

Sl No	**Course Content**	Hrs	COs
1	Roots of Algebraic and Transcendental Equation: Bisection Method, Iteration Method, Newton-Rapson Method, Method of False position.	5	CO1
2	Finite difference, Relation between operators, Interpolation for equal interval: Newton's Formula for Interpolation, Gauss's Interpolation Formula, Hermite Interpolation Formula, Starling Interpolation Formula, Bessel's Interpolation Formula.	5	CO2
3	Interpolation for unequal interval: Properties of divided differences, Newton's divided difference method, Lagrange's Interpolation Formula.	5	CO3
4	Curve Fitting, Cubic spline and Approximation.	5	CO4
5	Numerical Solution of Linear and Non-Linear System of Equations: Gaussian Elimination Method, Iterative Method, Method of Factorization, Newton-Raphson Method.	5	CO5
6	Numerical Differentiation and Integration. Numerical Solution of Ordinary Differential Equation: Solution by Taylor's series, Picard's Method of Successive Approximation, Euler's Method, Modified Euler's, Runge-Kutta method. Finite difference method, Adam Bashforth Method.	5	CO6
7	Numerical Solution of Partial Differential Equations	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. S. S. Sastry : Introductory Methods of Numerical Analysis
2. A. R. Bashishtha : Numerical Analysis 3. P. Henrici : Elements of Numerical Analysis
4. Burden, Faires : Numerical Analysis 5. J. B. Scarborough Jr. : Numerical Mathematical Analysis

2.6.4 MAT 3241 : Abstract Algebra

Course Code	MAT 3241	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:

Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1	Define and demonstrate Group, quasigroup, semigroup, and monoid; and Prove and illustrate the main theorems' arguments. Explain the symmetric and alternation groups, the permutation group, the cyclic group, and Lagrange's theorem. Demonstrate concept of subgroups, regular subgroups, cosets, and similar theorems.
CO2	Exhibit factual information, including mathematical notation terminology, and interpret the symbolism and simple concepts used in binary relations, groups, subgroups, monoids, homomorphism rings, ideals, and fields
CO3	Define homomorphism and isomorphism, as well as state and prove Caley's theorem and related theorems
CO4	Prove theorems about the composition, size, and nature of groups, quotient groups, circles, rings subrings, ideals, quotient rings, and the related mappings using the data, formulas, and methods studied in this course.
CO5	Define linear transformation and its underlying properties such as range, kernel, nullity, rank, singular and non-singular transformation; Describe linear transformation matrix representation.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3241 Abstract Algebra

Sl No	**Course Content**	Hrs	COs
1	Group, quasi group, semigroup and monoid. The symmetric and alternation group, Permutation group, Cyclic group, Lagrange's theorem.	7	CO1
2	Subgroup, normal subgroup, cosets and related theorems.	7	CO2
3	Homomorphsim, isomorphism, related theorems and Caley's theorem.	7	CO3
4	Ring, Subring, Integral domain, Ideal, quotient ring, field, Imbedding theorem, Euclidean ring.	7	CO4

5	Linear transformation: Range, kernel, nullity, rank, singular and non-singular transformation, Matrix representation of linear transformation.	7	CO5

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. Aggarwal, R.S : Modern Algebra 2. Balakrishan, R. : A Text book of Modern Algebra
3. Dean, R.A. : Elements of Abstract algebra 4. Herstein, I.N. : Topics in Algebra
5. Khanna, M.L. :Abstract Algebra 6. Paley, H. & Weicheel, P.M. :A first course in Abstract Algebra

2.6.5 MAT 3251 : Classical Mechanics

Course Code	MAT 3251	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Classical mechanics is a physical philosophy that describes the motion of macroscopic objects ranging from projectiles to machinery components, as well as astronomical objects such as satellites, planets, stars, and galaxies. If the current state of an object dominated by classical mechanics is understood, it is possible to determine how it will travel in the future (determinism) and how it has moved in the past (reversibility). When observing huge objects that are not massively huge and have speeds that do not exceed the speed of light, classical mechanics produces extremely precise results.

Objective: To demonstrate knowledge and comprehension of the following basic principles of mechanics: particle dynamics, rigid body motion, Lagrangian and Hamiltonian formulations.

Course Outcomes (COs): By the end of the course student will be able to

CO1	Explain the difference between a holonomic and a non-holonomic scheme. Develop and apply Lagrange's equation.
CO2	Create the Euler-Lagrange differential equation and apply it to rigid body motion without any force.
CO3	Determine the equations for motion in moving frames and motion relative to the Earth and the Pendulum of Foucault.
CO4	Explain simplified coordinates and talk about impulse motion, constant of motion, phase space, and small oscillations.
CO5	Declare the principle of Hamilton, Discuss Hamilton's equation, functions, and the Hamilton Jacobe equation.
CO6	Define the terms Lagrange, Poisson brackets, and Demonstrate knowledge of Contact transformation and Commutator.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 3251 Classical Mechanics

Sl No	**Course Content**	Hrs	COs

1	Holonomic and Non-Holonomic system and Lagrange's equation, Simple applications of Lagrange's equation.	7	CO1
2	Introduction to calculus of variation, Euler-Lagrange differential equation with Application, Euler's dynamical equation for rigid body motion, Motion under no force. 3.	7	CO2
3	Motion in rotating frames, Motion Relative to Earth Foucault's Pendulum.	6	CO3
4	Generalized coordinates and Lagrange, Impulsive motion, Ignoration of coordinates, Small oscillation, Constant of motion, Phase space.	6	CO4
5	Hamilton's equation, Hamilton's principle, Principle of least action, Hamilton's principle function and Hamilton Jacobe equation.	6	CO5
6	agrange and Poisson brackets Contact transformation, Commutator	6	CO6

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. Gupta, Kumar and Sharma : Classical Mechanics 2. Gupta, B.D. and Saha, S :Classical Mechanics

3. Goldstein, H. :Classical Mechanics 4. Rutherford :Classical Mechanics

5. Ganguli, S. :Classical Mechanics

2.6.6 FIN 3261 : Managerial Finance

Course Code	FIN 3261	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Managerial finance is a subfield of finance concerned with the managerial implementation of finance techniques. Through the distribution of limited capital among competing business opportunities, sound financial management provides value and operational agility. As a result, it assists in the execution and control of corporate plans, as well as the achievement of business goals.

Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1	Describe the goals of the financial management of organizations and firms.
CO2	Investigate financial management using the time value of money and other techniques.
CO3	Define cost of capital and address its significance for financial institutions/firms.
CO4	Calculate cost and return and assess project performance.
CO5	Discuss Capital Market Theory, Portfolio Risk Measures, The Capital Market Line, CAPM Theorem, Security Market Line, Sharpe ratio, Sortino ratio, VaR, and valuation of various types of securities.
CO6	Clarify capital budgeting and payback period (PBP), Internal Rate of Return (IRR) using interpolation, Net present value (NPV), Profitability Index (PI), Residual Earnings, and project evaluation
CO7	Describe and apply the dividend decision and policy.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

FIN 3261 : Managerial Finance

Sl No	**Course Content**	Hrs	COs
1	Introduction: Definition of finance, Functions of finance, Goal of a firm, Profit Maximization vs. Value creation Management vs. Shareholders. Conceptual framework-Financial decision making-Role of finance in a firm-Goal of financial management of a firm-Finance as a discipline- Financial Instruments-Financial Markets-Financial and Non Financial Institutions and Financial Regulatory Bodies -Agency Theory.	5	CO1
2	Time Value of Money: Concept, Reasons for Time Value of Money, Discounting and Compounding, Factors considered in time value of money- Size of the cash flows, Time between the cash flows, Rate of return/Interest rate, Simple Interest, Compound Interest, Single amount, Annuity, Mixed stream, Perpetuity.	5	CO2
3	Cost of Capital: Concept, Importance of Cost of Capital, Cost of Long-term Debt, Cost of Preferred Stock, Cost of Common Stock, Cost of Retained Earnings, Weighted Average Cost of Capital. Determinants of Markets Interest Rate.	5	CO3

4	Risk and Return: Financial and business risk-Leverage and risk-Measuring risk-Expected value-Risk premium-Risk and required return- Project risk and firm portfolio risk, Managerial option to manage risk	5	CO4
5	Valuation of Long Term Securities: Book Value vs. Market Value, Bond, Face value, coupon rate, bond with finite maturity, Semiannual compounding of interest, Preferred stock, and common stock valuation - Constant growth- yield to maturity (YTM) on bonds. Capital Market Theory and Portfolio Risk Measures, The Capital Market Line, CAPM Theorem, Security Market Line, Sharpe ratio, Sortino ratio, VaR.	5	CO5
6	Capital Budgeting: Capital budgeting and its process, Generating investment, Project proposals, Estimating project after tax incremental operating cash flow, Sunk cost and opportunity cost, Alternative methods for evaluation and selection of project, Payback period (PBP), Internal Rate of Return (IRR) under interpolation, Net present value (NPV), Profitability Index (PI), Residual Earnings.	5	CO6
7	Dividend Decision and Policy: Concept-Form of payments of Dividends- Dividend Policy-Types of dividend policies- Payment procedure of Dividend- Factors Affecting Dividend Policy- Relevance Concept of Dividend or the Theory of Relevance- Irrelevance Concept of Dividend or the Theory of Irrelevance.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. Gitman, Lawrence J. Principles of Managerial Finance, Pearson Education Inc., New Delhi, 2003.
2. Horne, James C. Van & Wachowicz, John M. Jr., Fundamentals of Financial Management, Pearson Education Inc. (Aisa), New Delhi, 2004.
3. Weston and Brigham: Managerial Finance.
4. A. O. Petters and X. Dong, An Introduction to Mathematical Finance with Applications (Springer, New York, 2016)

2.6.7 MAT 3272 : Numerical Simulation Lab Using Matlab/Python

Course Code	MAT 3272	CIE Marks	50
Credits	02	SEE Marks	50
SEE Hours	04	Total Marks	100

Rationale:

Objective:

Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2

CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 4.0 **(Credit :2.0)**

Course Content

1. Solution of Polynomial and transcendental equation and system of linear equation. 2. Interpolation and Polynomial Approximation. 3. Solution of system of linear equation. 4. Numerical Differentiation and Integration. 5. Numerical Solution of ordinary Differential and system of ordinary differential equations. 6. Numerical solution of partial differential equations and Integral equations. 7. Curve fitting.
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (4 hours) Examination of laboratory course: 50 marks.

2.6.8 MAT 3280 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester. A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.7 4th year 1st semester

2.7.1 MAT 4111 : Hydrodynamics

Course Code	MAT 4111	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: This course covers the development of the fundamental equations of fluid mechanics. The concepts of mass, momentum, and energy conservation, lift and drag forces, laminar and turbulent currents, dimensional analysis, added mass, and linear surface waves, including wave velocities, propagation phenomena, and explanations of actual sea waves, are all intended to be covered.
Objective: The course's objective is to provide students with fundamental and applied knowledge of fluid mechanics, which is needed in the design of effective ocean vessels, platforms, and structures.
Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Some basic properties of fluid. Velocity and acceleration of fluid particles. Lagrange's and Euler's method. Material and convective derivatives. Steady and unsteady flows. Uniform and non-uniform flows. 2. Streamline, pathline and Vortex line. Velocity potential, vorticity vector, rotational and irrotational flows, one, two and three dimensional flows, discharge. 3. Motion in two-dimension; Stream function, Physical meaning of stream function, velocity in polar coordinates. Relation between stream function and velocity potential. 4. Significance of the equation of continuity. Equation of continuity. Equation of continuity in curvilinear coordinates. Equation of continuity in spherical and polar coordinates. Equation of continuity of an incompressible fluid through a channel. Boundary surface. 5. Euler's equation of motion, conservative field of force; Lamb's hydrodynamical equations of motion; Bernoulli's equation; Motion under conservative body force, Vorticity equation, Helmhomrks vorticity equation. 6. Source, sink and doublet, complex potential and complex velocity, stagnation point; complex potential due to a source and a doublet, Uniform stream. Image in two and three dimensions, Image of a source and doublet w.r.to circle. Stokes theorem. 7. Flow and Circulation; Relation between circulation and vorticity. Kelvin's circulation theorem, Permanence of irrational motion, Equation of energy; Kelvin's minimum energy theorem. Circle's theorem, The Theorem of Blasius, the force exerted on a circular cylinder by a source, motion of a circular cylinder,

pressure at points on a circular cylinder and image system for a source outside circular cylinder. 8. Vortex motion, vortex tube; strength of a vortex, vortex pair, complex potential due to vortex motion, vortex rows, Free vortex, Forced vortex, spiral vortex, compound vortex. Image of a vortex filament in a plane, Image of a vortex outside and inside a circular cylinder.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Recommended Books:
1. F. Chorlton : Fluid dynamics Van-Nostrand
2. P.P. Gupta : Hydrodynamics
3. I.M. Milne Thomosn : Theoretical Hydrodynamics
4. M. D. Raishingania : Fluid Dynamics

2.7.2 MAT 4121 : Quantum Mechanics

Course Code	MAT 4121	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Quantum mechanics is a basic theory in physics that describes the physical properties of existence at the atomic and subatomic particle scales. It is the bedrock upon which all quantum physics is built, including quantum chemistry, quantum field theory, quantum technology, and quantum information science.
Objective: To acquire working knowledge of the Quantum Mechanics postulate on the physical systems, as well as the measurement and evolution of physical structures.
Course Outcomes (COs): By the end of the course student will be able to

CO1	Explain the terms Black body radiation, Planck's hypothesis, Planck's radiation law, Photo-electric effect, Einstein's Photon theory, Compton effect.
CO2	Comprehend Wave Particle Dualism for light and matter, the De Broglie wave, phase and group velocities, Wave packets and the state Uncertainty principle.
CO3	Demonstrate the understanding of Bohr Model of the Atom, Bohr's theory of the Hydrogen Spectrum, Spectral Series of Hydrogen Atom, Energy level of Hydrogen Atom and discuss Correspondence principle.
CO4	Interpret wave function, Derive Schrodinger wave equation, Expectation value and State Ehrenfest's theorem.
CO5	Finds the transmission one-dimensional square well potential, Interpret Postulates and energy eigen function. Computes momentum eigen function as well as find the energy eigen levels and evalute particle in a box. Define Box normalization, Dirac, function; Motion of a free wave packet, Minimum uncertainty product and minimum packet.
CO6	Discuss the dynamics of a particle in a spherically symmetric potential in a three-dimensions and the Hamiltonian equation.
CO7	Discuss the one-dimensional and three-dimensional square well potentials, as well as the hydrogen atom.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 4121 Quantum Mechanics

Sl No	**Course Content**	Hrs	COs
1	Basic Concept, Black body radiation, Planck's hypothesis, Planck's radiation law, Photo-electric effect, Einstein's Photon theory, Compton effect.	5	CO1
2	Wave Particle Dualism for light and matter, De Broglie wave, phase and group velocities, Wave packets, Uncertainty principle.	5	CO2
3	Bohr Model of the Atom, Bohr's theory of the Hydrogen Spectrum, Spectral Series of Hydrogen Atom, Energy level of Hydrogen Atom, Correspondence principle.	5	CO3
4	Wave Mechanical concepts, Schrodinger wave equation, Interpretation of wave function; Expectation value and Ehrenfest's theorem. Energy eigen function, One dimensional square well potential, Interpretative Postulates and energy eigen function.	5	CO4
5	Momentum eigen function, Box normalization, Dirac, function; Motion of a free wave packet, Minimum uncertainty product and minimum packet.	5	CO5
6	Linear harmonic oscillator. Spherically Symmetric potential in three-dimension.	5	CO6
7	Three-dimensional square well potential, Hydrogen atom, one-dimensional square potential barrier.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. Arther Beiser : Concepts of Modern Physics
2. L. I Schiff : Quantum Mechanics
3. P. T. Mathews : Introduction of Quantum Mechanics
4. Powell and Crassmann : Quantum Mechanics
5 Gupta, Kumar and Sharma : Quantum Mechanics
6 Donald Rao : Quantum Mechanics

2.7.3 MAT 4131 : Differential Geometry

Course Code	MAT 4131	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Differential geometry is the analysis of geometric properties using differential equations, integral calculus, and linear algebra. In the 18th and 19th centuries, the study of plane and space curves and surfaces in three-dimensional Euclidean space laid the foundations for the discovery of differential geometry.

Objective: The objective of the course is to explain how advanced calculus and linear algebra techniques can be used to give meaning to the definition of "texture" for curves and surfaces in space.

Course Outcomes (COs): By the end of the course student will be able to

CO1	Demonstrate the understanding of the curvature and torsion of a space curve. Determine the arc length and equations for the tangent, osculating plan, normal, principal normal, Binormal and fundamental planes. Determine the shape of the curve and osculating surface. Derive and apply the Serret-Frenet formula. Define the terms Helics, Osculating circle, Osculating sphere, Involute and Evolute.
CO2	Define smooth surface and construct examples. Produce the parametric equations for curve, tangent plane, normal and envelope. List the properties of two and three parameter family of surfaces.
CO3	Describe the first and second fundamental forms of a surface. Determine the direction coefficients, the orthogonal trajectories and the double family of curves.
CO4	Demonstrate and compute various forms of curvature associated with a surface. Interpret the statement of related theorems.
CO5	Define the terms developable surface, conjugate direction, and asymptotic line. Compose the statements of Monge's and Beltrami Enneper theorems.
CO6	Explain with examples of ruled and skew surface, parallel surface and the Bonnet's theorem isometric line.
CO7	Define Geodesic and derive the differential equation of geodesic. Write the Canonical geodesic equation and Geodesic on a surface of revolution. Recognize the statements of Clairaut's theorem and Gauss-Bonnet theorem. Discuss the terms differential Manifold, connection and curvature on a Manifold.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 4131 Differential Geometry

Sl No	**Course Content**	Hrs	COs
1	Curves in space: Parametric representation, arc length, Tangent, Osculating plane, Normal, Principal normal, Binormal and fundamental planes. Curve: Curvature and torsion, Serret-Frenet formula, Helics, Osculating circle, osculating sphere, Involute and Evolute.	7	CO1
2	Surface: Parametric equation, Parametric curve, Tangent plane, normal and envelope, two and three parameter family of surfaces.	5	CO2
3	First and second fundamental forms, Direction coefficients, orthogonal trajectories, Double family of curves.	5	CO3
4	Curves on a surface: Normal curvature and section Meusnier,s theorem, Principal section, Curvature and direction, Rodrigue,s formula, Euler's theorem, Minimal surface.	5	CO4
5	Developable surface, Monge's Theorem, Conjugate direction, Asymptotic line, Theorem of Beltrami Enneper.	5	CO5
6	Ruled and skew surface, parallel surface and Bonnet's theorem isometric line.	5	CO6
7	Geodesic: Definition, Differential equation of geodesic. Canonical geodesic equation, Geodesic on a surface of revolution, Clairaut's theorem, Gauss-Bonnet Theorem. Differential Manifold, connection and curvature on a Manifold.	5	CO7

Recommended Books:

1. H.Guggen, Heimer : Differential Geometry
2. D.J. Struik : Classical Differential Geometry
3. J.N. Sharma and A.R. Basishtha : Differential Geometry
4. M.L. Khanna : Differential Geometry
5. C. Weathcrburn : Differential Geometry of three Dimensions
6. T.J. Willmore : An Introduction to Differential Geometry
7. S. Stamike : Differential Geometry

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

2.7.4 MAT 4141 : Integral Equation

Course Code	MAT 4141	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:
Objective:
Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Types of Integral Equation (IE), Differentiation under an integral sign, Relation between differential and integral equation. 2. Solution of the Volterra Integral Equation (VIEs) and Fredholm Integral Equation (FIEs) of the first and second kinds. 3. Fredholm's First Second and Third fundamental theorem. 4. Application of Fredholm's theorems,Fundamental function, 5. IEs with degenerate kernel, Eigenvalue & eigen function. 6. Symmetric kernel, Orthogonal & Normalised system, Schmidt,s solution of non-homogeneous IEs, Hilbert Schmidt theorem. 7. Construction of Green's function, Influence function, IE & Green's function for BVPs. 8. Singular IEs, Cauchy principal integral, Hilbert kernel & Hilbert formula. Solution of Hilbert type IEs of the first & second kinds.

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. Shanti Swarup Integral Equations
2. M.D. Raishinghania Linear Integral Equations
3. R.P. Kanwal Linear Integral Equations

4. T.G. Tricomi Integral Equations
5. A.R. Vashishtha Integral Equations

2.7.5 MAT 4151 : Topology

Course Code	MAT 4151	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Some geometric properties are determined not by the actual form of the structures concerned, but rather by how they are assembled. Topology is the study of properties that are invariant under specific types of transformations (called continuous maps). Topological spaces appear in nearly every branch of mathematics. As a result, topology has become one of the major unifying concepts of mathematics.
Objective: To apply the definitions of open and closed sets in an abstract manner, rather than just by the real line approach.
To introduce students to the applications of above to proving continuous functions.
Course Outcomes (COs): By the end of the course student will be able to

CO1	Critically explain the concepts topology and topological space, as well as prove topological theorems.
CO2	Define and construct topological and counter-topological examples under the real line and plane.
CO3	Define Metric space, Metric topology, and explore Properties of Metric Space, as well as solve problems.
CO4	Discuss Metrizable Space and describe Convergence and Continuity of Metric Space.
CO5	Define Countability, as well as the properties of First countable space, Second countable space, and related theorems.
CO6	Define compactness and explain the terminology listed in the course.
CO7	Critically discuss T1-space, Hausdorff space, Regular space. Using examples, define and explore the properties of completely normal space, and regular space

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

MAT 4151 Topology

Sl No	**Course Content**	Hrs	COs
1	Topology and Topological space: Open set and Closed set, Closure of a set, Interior, Exterior and Boundary, Neighborhood and Neighborhood systems, Weak and strong Topology	6	CO1
2	Topology of the real line and plane: Co-finite and Countable topology, Subspace, Relative topology, Bases and Sub-bases for a topology, Continuity and Topological equivalence, Homeomorphism space	6	CO2

3	Metric Space: Metric topology, Properties of metric space, and their problems	6	CO3
4	Metrizable Space: Convergence and Continuity in metric space, Normed space.	5	CO4
5	Countability: First countable space, Second countable space and related theorems	5	CO5
6	Compactness: Cover, Compact set, Subset of a compact space, Finite intersection property, Bolzano-Weierstrass theorem, locally compact space, Separated set, connected set, connected space, Component, Locally connected space and simply connected space.	6	CO6
7	Separation axioms: T1-space, Hausdorff space, Regular space, Definition and properties, completely normal space and completely regular space.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.

Recommended Books:

1. Lipschutz, S. General Topology
2. Simmons, G.F. Introduction to Topology and Modern Analysis
3. Gal, S. Point Set Topology
4. Kelley, J.L. General Topology
5. Hockling and Young Topology

2.7.6 MAT 4162 : Mathematical Modeling Lab uisng FORTRAN/Matlab

Course Code	MAT 4162	CIE Marks	50
Credits	02	SEE Marks	50
SEE Hours	04	Total Marks	100

Rationale:

Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 4.0 **(Credit : 2.0)**

Course Content

POPULATION DYNAMICS, SINGLE SPECIES: A single species with limited resources, deterministic approach: logistic equation, geometric approach, linearized stability analysis.
POPULATION DYNAMICS, COMPETITION OF SPECIES:Two competing species: deadly

survival struggle between sheep and Rabbits, Predator-prey oscillation:LotkaVolterra equation. Logistic map: fixed point, stability, oscillation, chaos. Why is the logistic map behavior so much richer than of the continuous logistic equation. CLIMATE:Energy balance model, greenhouse warming to snowball earth, Stochastic model of Climate variability, Thermohaline circulation. TRAFFIC FLOW: Single-car approach, Macro approach
Diffusion equation: Derivation of the 1d and 2d diffusion equations and solution.
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (3 hours) Examination: 50 marks.
Recommended Books:
1. Adam, J. (2003). Mathematics in Nature. Princeton university press.
2. Burden, R. L. and Faires, J. D. (2004). Numerical Analysis. Brooks Cole, 8 edition.
3. Chopard, B. and Droz, M. (paperback, 2005). Cellular automata modeling of physical systems. Cambridge University Press.
4. Haberman, R. (2003). Applied Partial Differential Equations, Fourth Edition. Prentice Hall.
5. Roberts, F. S. (1976). Discrete mathematical models. Prentice-Hall.

2.7.7 MAT 4170 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.
A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.

2.8 4th year 2nd semester

2.8.1 MAT 4211 : Operation Research

Course Code	MAT 4211	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:
Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Basic Concepts: Introduction, The nature, Meaning, Scope and role of Operations Research. Main phases of Operations Research (OR). 2. Linear Programming: Concept and Basic elements of Linear Programming (LP), Formulation of Linear Programming Problems. Solution of Linear Programming. Problems by Graphical Method. 3. Solution of LP Problems by using Simplex Method, Reverse Simplex Method, Two phase method, Big-M method. 4. Duality in Linear Programming. Solution of LPP by Dual simplex method. 5. Transportation and Assignment problems. 6. Decision making and decision tree in Operation Research. Dynamic Programming problems. 7. Basic concepts of Game theory, two persons and n-persons zero-sum game and its solutions, Solutions of $2 \times n$ and $m \times 2$ Games using dominance and graphical methods.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Gupta, D.K. and Mohan M : Linear Programming and Theory of Games 2. Berger J.O : Statistical Decision Theory
3. Charles, A : Decision Making under Uncertainty
4. Gass, S.I. : Linear Programming
5. Hudly, G : Linear Programming
6. Lindly, D.V : Making Decision
7. Taha, H.A. : Operation Research: An Introduction
8. Vajda S. : Game Theory
9. Hira & Gupta : Operation Research

2.8.2 MAT 4221 : Astronomy

Course Code	MAT 4221	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:
Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Elements of Spherical trigonometry: Spherical and Polar triangles, Cosine, sine, cotangent and polar formule, Analogues of cosine formula, Napier's and Delambre's analogies.
2. Celestial Coordinate System: Different kinds of coordination system, Relation between different coordinate systems, Celestial sphere, Midnight sun, Circumpolar star, Setting, Rising and twilight.
3. Refraction: Astronomical refraction, laws of refraction, effect of refraction on celestial bodies, coefficient of refraction and its determination, Cassini's hypothesis, Bradley's formula.
4. The Solar system and Planetary motion: Main feature of the solar system, solar planet, sidereal and synodic periods of solar planet, direct and retrograde motions, elongation, phase of the moon, Bode law, Kepler's laws of planetary motion, Anomalies.
5. Time, seasons: Different kinds of times, conversion of times, year, mean sun, apparent sun, the equation of time and its measurement, equation of centre, reduction to the equator, astronomical seasons and their causes, lengths of different seasons.
6. Aberration, Precession and Nutation: Aberration, aberrational error, apex, effect of aberration on celestial bodies, effect of aberration on right ascension and declination, longitude and latitude of a star, aberrational ellipse, planetary aberration, precession and nutation of equinoxes and their causes, planetary precession, effect of precession and nutation on right ascension and declination of a star.
7. Parallax: Geocentric and heliocentric parallaxes, effect of parallaxes on heavenly bodies, parallax in the distance between two planets, annual parallaxes in longitude and latitude of a heavenly body, the paralytic ellipse, stellar parallax in right ascension and declination.
8. Eclipses: Solar and lunar eclipses, circumstances of eclipses, causes and conditions of eclipses, the ecliptic limits, calculation of solar and lunar eclipses, frequency of eclipses, the soars, the mitotic cycle.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.

Recommended Books:
1. Smart : Spherical Astronomy
2. Godtrey : Spherical trigonometry
3. J. M. Kar : Astronomy
4. Datta & Choudhary : Astronomy
5. Todhunter : Spherical trigonometry
6. Khan and Sikder : Astronomy

2.8.3 MAT 4231 : Special Theory of Relativity

Course Code	MAT 4231	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale:
Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 3.0 **(Credit : 3.0)**

Course Content

1. Experimental Background: Galilean transformation, Newtonian relativity, Relativity of electrodynamics, Michelson-Morely experiment, Attempts to preserve Ether frame, Limitation of Galilean transformation, Findings and possibilities. 2. Postulates of special relativity, Lorentz transformation and their consequences, Length contraction, Time dilation and simultaneity. 3. Relativistic addition of velocities, Transformation of velocities and accelerations, Composition of Lorentz transformation, Aberation and Doppler Effect of relativity. 4. Relativistic Dynamics: Relativistic mass, Relativistic momentum, Relativistic force law and the dynamics of a single particle, Relativistic energy and Acceleration. 5. Equivalence of mass and energy, Transformation properties of momentum, energy, mass, and force. 6. Relativity and Electromagnetism: Interdependence of electric and magnetic fields, Transformation for electric and magnetic fields, Maxwell's equation in tensor form. 7. Four-Vector Formalism, Minkowski spacetime, Time order and space separation of events, Proper time, Twin paradox, Minkowski force. 8. Principle of Least Action: The Lagrangian, Conservation of momentum four-vector and angular momentum tensor. Conservation of Energy-momentum tensor of the electromagnetic field: Poynting,s law, Energy density, Energy current density, Momentum density, Momentum current density.
Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:

1. R. Resnick : Introduction to Special Relativity
2. A. Qadir : Relativity: An Introduction to the Special Theory
3. U.E. Schröder : Special Relativity
4. F.N.H. Robinson : An Introduction to Special Relativity and it applications
5. B. F. Schuttz : Geometrical Methods of Mathematical Physics

2.8.4 MAT 4241 : Theory of Number

Course Code	MAT 4241	CIE Marks	30
Credits	03	SEE Marks	70
SEE Hours	03	Total Marks	100

Rationale: Number theory is one of the most ancient and beautiful branches of Pure Mathematics. Many number theory questions can be expressed in a relatively simple language. Its application is to cryptographic systems that enable banks, commercial firms, military institutions to share information.
Objective: This course intends to educate students with a solid foundation in Number Theory from a contemporary viewpoint. It offers a systematic development of Number Theory using axioms, definitions, interpretations, theorems, and proofs. **Course Outcomes (COs):** By the end of the course student will be able to

CO1	Describe the Mathematical Induction method. State and apply the Binomial theorem, the Prime number theorem, the Division algorithm. Outline the relationship between GCD and LCM and their properties, and solve Diophantine equations.
CO2	Recognize the statement of the Fundamental Theorem of Arithmetic, find prime numbers using Eratosthenes' sieve algorithm, and claim and prove Goldbach's conjecture.
CO3	Define and describe the Theory of Congruence and its properties, as well as explain linear congruence and perform the Special Divisibility test.
CO4	Discuss the Factorization Method and apply theorems applicable to it.
CO5	Explain Number Theoretic Functions, Apply the Mobius inversion theorem, then define and use the greatest integer function.
CO6	State Euler's theorem and the Generalized Fermat's theorem, and define phi-Function properties. Discuss the use of cryptography in applications.
CO7	Define and address the Fibonacci sequence and the Fibonacci number as well as their applications. Explain the finite and infinite continuing fractions.

Contact Hr/Week: 3.0 **(Credit : 3.0)**

MAT 4241 : Theory of Number

Sl No	**Course Content**	Hrs	COs
1	Basic Concepts: Mathematical Induction, The Binomial theorem, Prime number theorem Divisibility Theory: The division Algorithm, The greatest common divisor, The Euclidean Algorithm, The Diophantine equations	7	CO1

2	Primes and their Distribution: The Fundamental theorem of Arithmetic, The sieve of Eratosthenes, The Goldbach conjecture.	6	CO2
3	The Theory of Congruence: Basic concepts, Basic properties of congruence, Linear congruence , Special Divisibility test,	6	CO3
4	Factorization Method: Fermat's theorem, Fermat's factorization method. The little theorem, Wilson's theorem, Fermat's last theorem (statement).	5	CO4
5	Number Theoretic Function: Function and Mobius inversion formula, The greatest integer function.	5	CO5
6	Euler's Generalization of Fermats Theorem: Euler's phi-Function, Euler's theorem, Properties of the phi- Function. An application to cryptography.	5	CO6
7	Fibonacci Number and Continued Fraction: The Fibonacci sequence, Fibonacci number, Finite continued fraction, Infinite continued fraction.	5	CO7

Evaluation: Class attendance: 10 marks, Continuous assessment: 20 marks, Semester Final (3 hours) Examination: 70 marks.
Seven questions of equal value will be set, of which five are to be answered.
Recommended Books:
1. Burton, D.M. : Topics in Number Theory
2. Hardy, G.M. and Wright, E.M. : An Introduction to the Number Theory.
3. Apostol : Theory of Numbers
4. Chowdhury, F. : Essentials of Number Theory
5. Niven and Zucherman : Theory of Numbers
6. Hunter, J. : Number Theory

2.8.5 MAT 4242 : Operation research and Cryptography Lab

Course Code	MAT 4242	CIE Marks	50
Credits	03	SEE Marks	50
SEE Hours	03	Total Marks	100

Rationale:
Objective: Course Outcomes (COs): By the end of the course student will be able to

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Contact Hr/Week: 2.0 **(Credit : 2.0)**

Course Content

Operation research: Linear Programming, Graphical Solution, Simplex Method (Artificial Variable Techniques, Using The Dual Simplex Method), Transportation Problem, Assignment Problem, Game Theory.
Cryptography: Prime Numbers, Perfect numbers, Congruence relation, Coprime, Euler totient Remainder theorem, RSA algorithm,Shannon's Theory
Evaluation: Class attendance: 10 marks, Continuous assessment: 40 marks, Semester Final (3 hours) Examination: 50 marks.
Recommended Books:
1. Niven and Zucherman : Theory of Numbers
2. Hudly, G : Linear Programming

2.8.6 MAT 4253 : Project in Mathematics

Contact Hr/Week: 4.0 **(Credit : 4.0)**

Each student is required to work on a project and present a project report for evaluation. Such projects should be extension or application of materials included in different honours courses and may involve field work and use of technology. There may be group projects or individual projects.
Implementation and Evaluation of the Project:
The Academic Committee shall appoint a project Implementation and coordination Committee (PICC) before the session begins. The PICC shall consist of a project Coordinator (PC) and such other members as the Academic Committee considers appropriate. The PC shall invite projects from the teachers before the class start. Each teacher should submit three project proposal should include a short description of the project. Such projects should be extension of applications of materials included in different honors courses, and may involve field work and use of technology. There may group projects as well as individual projects. For group projects, students will sign up with the PICC in groups of three. These may not be changed later on without approval of the PICC.
The PICC shall assign each group a project. The members of each group shall work independently on the assigned project under the supervision of the concerned teacher. The PICC shall monitor with the supervisors the progress of different projects and arrange weakly discussions on projects and materials.
Completion: The project must be completed before termination of the classes. Each student is required to prepare a separate report on the project. Each report should be of around 40 pages typed on one side of A4 size white paper preferable using word processors. Graphs and figures should be clearly drawn preferably using computers. Reports of different students working on the same group project should differ in some details and illustrations. The Academic Committee will fix a data for the submission of the projects to the PICC. Each student must submit three typed copies of her/his project report to the PICC on or before the date fixed for such submission.
The PICC, on receiving the reports will arrange the presentation of by individual students before the PICC. This presentation should take palace soon after the completion of the written examination. Any student who fails to submit the report on the due date or to present the thesis on the fixed date will not get any credit for this course.
Evaluation: The distribution of marks for each project shall be as follows:

Sl.	Project Items	Marks
1	Project Report evaluation	60%
2	Project Presentation and Viva-Voce	40%
	Total	100%

Each project report shall be examined by two examiners, one of whom shall be project supervisor and the other appointed from amongst the teachers of the department of the recommendation of the PICC. In case the marks of the two examiners of a project report differ by more than 20% a third examiner for that report shall be appointed from amongst the teachers of the department on the recommendation of the PICC. In such cases the final marks shall be determined according to the usual procedure.
Each student is required to present her/his work on the project before the PICC who will evaluate the presentation. The Academic Committee may prepare additional guidelines for evaluation of the projects.
All marks on the projects shall be submitted to the Examination Committee for tabulation with copies to the Controller of Examination. The project reports shall be returned to the PICC for preservation.

2.8.7 MAT 4260 : Viva-Voce

Contact Hr/Week: 1.0 **(Credit : 1.0)**

Course Content

Content of the Viva-Voce shall be the contents of mathematics courses of the semester. Student will be able to define, state, explain, illustrate, simplify and apply various mathematical terms and theorems related to the courses of the semester.
A Viva-Voce will be held on at the end of the semester. Student shall be asked questions on the courses of the current semester.