ROYAL GLOBAL UNIVERSITY
GUWAHATI

Royal School of Applied & Pure Sciences (RSAPS)

Department of Mathematics

Learning Outcomes based Curriculum Framework (LOCF)

For Undergraduate Programme

B.Sc. (Honours) in Mathematics

2022

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1. Preamble

Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation.

A holistic and multidisciplinary education would aim to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess.

As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education at making higher education multidisciplinary learning process. In other words, the curriculum will be flexible, it will allow students to take up creative subject-combinations.

The new curriculum of B.Sc.-Honours in Mathematics under The Assam Royal Global University will be more flexible, multi-disciplinary and holistic.

2. Introduction

The prime focus of the syllabus aims at a new and forward-looking Vision for India's Higher Education System. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion-- moving towards a more multidisciplinary undergraduate education, revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences etc. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. Looking at all these new concepts and progress, the detailed syllabus of B.Sc. (H) Mathematics has been designed.

3. Approach to Curriculum Planning

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Bachelor's Degree (Hons) programmes are earned and awarded on the basis of (a) demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and (b) academic standards expected of graduates of a programme of study.

The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery, and review of academic programmes.

Learning outcomes-based frameworks in any subject must specify what graduates completing a particular programme of study are (a) expected to know, (b) understand and (c) be able to do at the end of their programme of study. To this extent, LOCF in Mathematics is committed to allowing for flexibility and innovation in (i) programme design and syllabi development by higher education institutions (HEIs), (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within institutional parameters as well as LOCF guidelines, (v) generating framework(s) of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes.

The key outcomes that underpin curriculum planning and development at the undergraduate level include Graduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes.

The LOCF for undergraduate education is based on specific learning outcomes and academic standards expected to be attained by graduates of a programme of study. However, an outcome-based approach identifies moves way from the emphasis on what is to be taught to focus on what is learnt by way of demonstrable outcomes. This approach provides greater flexibility to the teachers to develop—and the students to accept and adopt—different learning and teaching pedagogy in an interactive and participatory ecosystem. The idea is to integrate social needs and teaching practices in a manner that is responsive to the need of the community. HEIs, on their turn, shall address to the situations of their students by identifying relevant and common outcomes and by developing such outcomes that not only match the specific needs of the students but also expands their outlook and values.

3.1 Nature and extent of the B.Sc. (Hons.) Mathematics

Mathematics is the study of quantity (number theory), structure (algebra), space (geometry) and change (mathematical analysis). It has wide range of applications in natural sciences, engineering,

economics, social sciences and even bio and medical sciences. The key areas of study in mathematics are:

I. Real & Complex analysis
II. Calculus
III. Abstract Algebra
IV. Number Theory
V. Graph Theory
VI. Differential Equations (including Mathematical Modelling)
VII. Linear Algebra
VIII. Metric Spaces and Topology
IX. Numerical Analysis
X. Mechanics

To broaden the interest for interconnectedness between formerly separate disciplines one can choose from the list of Generic electives for example one can opt for economics, physics, chemistry or any other subject of interest offered by different departments and schools of the Assam Royal Global University as one of the GE papers. Skill enhancement Courses enable the student acquire the skill relevant to the main subject. Choices from Discipline Specific Electives provides the student with liberty of exploring his interests within the main subject. Communication English and Behavioural Science are compulsory papers for students of B.Sc. (H) in Mathematics which enable them to be better communicator and develop better personality.

As a part of effort to enhance employability of mathematics graduates, the well- structured programme empowers the students with the skills and knowledge leading to enhance career opportunities in various sectors of human activities.

3.2 Aims of B.Sc. (H) Programme in Mathematics

The overall aims of B.Sc. (Hons) Mathematics Programme are:

- To create strong interest in learning mathematics.
- To develop broad and balanced knowledge and understanding of definitions, concepts, principles and theorems.
- To enable the learners to familiarize with suitable tools and skill of mathematics to solve specific problems of both theory and applications.
- To provide sufficient knowledge and skills that enable the learners to undertake further studies in mathematics and the areas on multiple disciplines concerned with mathematics.
- To encourage the students to develop a range of generic skills helpful in employment, internships and social activities.
- To impart research-based knowledge to create interest for further study.

4. Graduate Attributes in Mathematics

Some of the graduate attributes in mathematics are listed below:

4.1 **Disciplinary knowledge:** Ability of demonstrating comprehensive knowledge of

mathematics and its subfields, and its applications to one or more disciplines.

4.2 **Communications skills:** Capability to express various concepts of mathematics in effective and coherent manner using examples and visualizing their geometrical meaning both in writing and speaking; ability to present the complex mathematical ideas in clear, precise and confident way; ability to explain the development and importance of mathematics in various scientific developments; capability to communicate thoughts and views in mathematically or logically correct statements.

4.3 **Critical thinking**

i) Ability to employ mathematical foundations, critical thinking in understanding the concepts in every area of mathematics and allied areas.

ii) Capability to formulate mathematically correct arguments

4.4 **Analytical reasoning:**

Ability to analyze the results and apply them in relevant various problems appearing in different branches of mathematics.

4.5 **Problem solving:** Capacity to use the earned knowledge to solve different non-familiar problems and apply the learning to real world situations; capability to solve problems in computer graphics using concepts of linear algebra; Capability to apply the acquired knowledge in differential equations to solve specific problems in other disciplines.

4.6 **Research-related skills:**

i) Potentiality to think and inquire about relevant/appropriate questions, ability to define problems, formulate and test hypotheses, formulate mathematical arguments and proofs, draw conclusions; ability to write the obtained results clearly.

ii) To know about the developments in various branches of mathematics.

4.7 Information/digital literacy:

i) Ability to use ICT tools in solving problems or earning knowledge;

ii) Capacity to use appropriate software and programming skills to solve problems in mathematics,

4.8 **Self-directed learning:** Potentiality to work independently and do in-depth study of various concepts of mathematics., ability to search relevant resources and e- resources for self-learning and amplifying knowledge in mathematics.

4.9 **Moral and ethical awareness/reasoning:** Ability to identify unethical behaviour such as fabrication or misrepresentation of data, committing plagiarism, infringement of intellectual property rights and adopting objective, unbiased and truthful actions in all aspects.

4.10 **Lifelong learning:** Ability to earn knowledge and skills through self-learning that helps in personal development as well as skill development to make them suitable for changing demands of work place.

5. Qualification descriptors for B.Sc. (Hons.) Mathematics

The course structure of B.Sc. (Hons.) in mathematics covers a full range of mathematical domain

starting from Calculus to Analytical Geometry, Differential Equations, Statics and Dynamics to learn about the geometry of sciences. Linear Algebra, Real Analysis, Complex Analysis are introduced to discuss algebraic structures on finite dimensional spaces as well as Metric Spaces and Topology, Abstract Algebra are introduced to understand algebraic structures on infinite dimensional spaces. Also, to learn the application techniques in all the branches of engineering, sciences, biosciences, economics and finance etc. different courses like Numerical Methods & LPP, Number Theory and Graph Theory, Fourier Series and Transform Calculus, Hydrostatics, Introduction to Mathematical Modelling, Introduction to Probability & Statistics, Hydrodynamics, Rigid Dynamics, Combinatorics & Mathematical Logic are designed. We also introduce Spherical Trigonometry and Astronomy to impart knowledge to identify and analyze the positions and directions of celestial bodies in the universe. The Programme, B.Sc. (Hons.) in mathematics covers exceptionally a broad range of pure & applied mathematics. The learning parameters of B.Sc. (Hons.) in mathematics can impart knowledge to generate analytical and logical thinking. To expand the interest and acquire basic knowledge of other disciplines generic electives papers are included for example one can opt for physics/ chemistry/ statistics/economics as one of the GE papers. Ability Enhancement Compulsory Course like Communicative English / Environmental Science, enable the student acquire the skill relevant to the main subject. Discipline Specific Electives course provides liberty of exploring interests within the main subject. The learning experience and procedures are so designed that every student with mathematics may achieve the programme learning outcomes with equal opportunity.

On pursuing graduation in mathematics, a student should be able to demonstrate mathematical applications in engineering, science & Technology, mathematical sciences. The qualification descriptors for B.Sc. (Hons.) Mathematics may include the following:

- To develop their educational skills in each area of pure mathematics as well as in applied mathematics and apply knowledge and skills to identify the unsolved problems in mathematics.
- To identify challenging mathematical problems, analyze and evaluate these problems using appropriate methodologies and obtain well-defined solutions.
- To apply the acquired knowledge in mathematics and transferable skills to real-life problems.
- To achieve learning requirements in mathematics and their applications in diverse areas of mathematical sciences.
- To provide opportunities in research, academia, and technical institutes. Career opportunities can include jobs at financial companies, government sector, software developers, marketers and bankers.

6. Programme Learning Outcomes in B.Sc. (Hons.) Mathematics

6.1 Programme Outcomes

PO1: Knowledge of Mathematics:

Ability of demonstrating comprehensive knowledge of mathematics and its subfields, and its applications to one or more disciplines.

PO2: Communications skills:

Capability to express various concepts of mathematics in effective and coherent manner using examples and visualizing their geometrical meaning both in writing and speaking; ability to present the complex mathematical ideas in clear, precise and confident way; ability to explain the development and importance of mathematics in various scientific developments; capability to communicate thoughts and views in mathematically or logically correct statements.

PO3: Critical thinking

i) Ability to employ mathematical foundations, critical thinking in understanding the concepts in every area of mathematics and allied areas.

ii) Capability to formulate mathematically correct arguments

PO4: Analytical thinking:

Ability to analyze the results and apply them in relevant various problems appearing in different branches of mathematics.

PO5: Problem solving:

Capacity to use the earned knowledge to solve different non-familiar problems and apply the learning to real world situations; capability to solve problems in computer graphics using concepts of linear algebra; Capability to apply the acquired knowledge in differential equations to solve specific problems in other disciplines.

PO6: Research-related skills:

iii) Potentiality to think and inquire about relevant/appropriate questions, ability to define problems, formulate and test hypotheses, formulate mathematical arguments and proofs, draw conclusions; ability to write the obtained results clearly.

iv) To know about the developments in various branches of mathematics.

PO7: Information Literacy/ Digital literacy:

- Ability to use ICT and other online tools in solving problems or earning knowledge.
- Capacity to use appropriate software and programming skills to solve problems in mathematics.

PO8: Self-directed learning

Potentiality to work independently and do in-depth study of various concepts of mathematics., ability to search relevant resources and e- resources for self-learning and amplifying knowledge in mathematics.

PO9: Moral and ethical Learning

Ability to identify unethical behaviour such as fabrication or misrepresentation of data, committing plagiarism, infringement of intellectual property rights and adopting objective, unbiased and truthful actions in all aspects.

PO10: Life Long Learning

Ability to earn knowledge and skills through self-learning that helps in personal development as well as skill development to make them suitable for changing demands of work place.

6.2. Programme Specific Outcomes

PSO-1: Enable a student to be better and effective communicator of mathematics by written, computational and graphical means.

PSO-2: Ability to illustrate mathematical ideas from basic theorems and axioms.

PSO-3: Ability to apply mathematics to solve, analyze theoretical problems of mathematics.

PSO-4: Enable a student to identify applications of mathematics in other disciplines and in the real-world, leading to enhancement of career prospects in a relevant fields and research.

7 Teaching Learning Process

Teaching and learning in this programme involve classroom lectures, computer lab and tutorials.

It allows-

- The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.
- Written assignments and projects submitted by students
- Project-based learning
- Group discussion
- Home assignments
- Class tests
- Quizzes
- PPT presentations, Seminars, interactive sessions
- Co-curricular activity etc.
- Industrial Tour or Field visit

8. Programme Evaluation

8.1 The Programme structures and examinations shall normally be based on Semester System. However, the Academic Council may approve Trimester/Annual System for specified programmes.

8.2 In addition to end term examinations, student shall be evaluated for his/her academic performance in a Programme through, presentations, analysis, homework assignments, term papers, projects, field work, seminars, quizzes, class tests or any other mode as may be prescribed in the syllabi. The basic structure of each Programme shall be prescribed by the Board of Studies and approved by the Academic Council.

8.3 Each Programme shall have a number of credits assigned to it depending upon the academic load of the Programme which shall be assessed on the basis of weekly

contact hours of lecture, tutorial and laboratory classes, self-study. The credits for the project and the dissertation shall be based on the quantum of work expected.

8.4 Depending upon the nature of the programme, the components of internal assessment may vary. However, the following suggestive table indicates the distribution of marks for various components in a semester: -

	Component of Evaluation	**Marks**	**Frequency**	**Code**	**Weightage (%)**
A	**Continuous Evaluation**				
	Analysis/Class test	Combination of any three from (i) to (v) with 5 marks each	1-3	C	25%
	Home Assignment		1-3	H	
	Project		1	P	
	Seminar		1-2	S	
	Viva-Voce/Presentation		1-2	V	
	MSE	MSE shall be of 10 marks	1-3	Q/CT	
	Attendance	Attendance shall be of 5 marks	100%	A	5%
	Semester End Examination		1	SEE	70%
					100%

9. Course Structure of B.Sc. (Hons.) Mathematics

Semester wise Details of B.Sc. (Hons.) Mathematics Course & Credit Scheme

1st Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT012C101	Calculus (Differential & Integral)	3	1	0	4	4
2	MAT012C102	Classical Algebra and Trigonometry	3	1	0	4	4
3	MAT012C103	Differential Equations (ODE &PDE)	3	1	0	4	4
Skill Enhancement Course (SEC)							
4	MAT012S101	Mathematics for Competitive Examinations	2	0	0	2	2
Value Addition Course (VAC)							
5	MAT012V101	Select one course from a basket of course	2	0	0	2	2
Generic Elective (GE)							
6	MAT012G101	Mathematics-I	3	0	0	3	3
7	MAT012G102	Fundamentals of Mathematics	3	0	0	3	3
Ability Enhancement Course (AEC)							
8	CEN982A101	Communicative English-I	1	0	0	1	1
9	BHS982A102	Behavioural Science-I	1	0	0	1	1
Total Credit:24							

2nd Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT012C201	Vector analysis and Linear Algebra	3	1	0	4	1
2	MAT012C202	Analytical Geometry (2D & 3D)	3	1	0	4	1
3	MAT012C203	Introduction to data science	3	1	0	4	1
Skill Enhancement Course (SEC)							
4	MAT012S201	SEC2 (Statistical tools SPSS/R)	1	0	2	2	3
Value Addition Course (VAC)							
5	MAT012V201	VAC2	2	0	0	2	2
Generic Elective (GE)							
6	MAT012G201	Mathematics-II	3	0	0	3	3
7	MAT012G202	Aptitude and Quantitative Ability	3	0	0	3	3
Ability Enhancement Course (AEC)							
8	CEN982A201	Communicative English-II	1	0	0	1	1
9	BHS982A202	Behavioural Science-II	1	0	0	1	1
Total Credit:24							

3rd Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT012C301	Real Analysis-I	3	1	0	4	4
2	MAT012C302	Mechanics-I (Statics and Particle dynamics)	3	1	0	4	4
Discipline Specific (DSE) (Any one)							
3	MAT012D301	Ordinary Differential Equations	3	1	0	4	4
	MAT012D302	Business Mathematics	3	1	0	4	4
Generic Elective (GE)							
4	MAT012G301	GE5	3	0	0	3	3
5	MAT012G302	GE6	3	0	0	3	3
Ability Enhancement Course (AEC)							
6	CEN982A301		1	0	0	1	1
7	BHS982A302		1	0	0	1	1
Internship							
8		4 weeks internship after 2nd em	0	0	0	4	4
Total Credit:24							

4th Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT012C401	Abstract Algebra	3	1	0	4	4
2	MAT012C402	Complex analysis	3	1	0	4	4
Discipline Specific (DSE) (any one)							
3	MAT012D401	Partial Differential Equations	3	1	0	4	4
	MAT012D402	Mechanics-II	3	1	0	4	4
Skill Enhancement Course (SEC)							
4	MAT012S411	SEC3 (Mathematical programming tools)	0	0	4	2	4
Value Addition Course (VAC)							
5	MAT012V401	Select one course from a basket of course	2	0	0	2	2
Generic Elective (GE)							
6	MAT012G401	GE7	3	0	0	3	3
7	MAT012G402	GE8	3	0	0	3	3
Ability Enhancement Course (AEC)							
8	CEN982A401	AECC7 (CEN4)	1	0	0	1	1
9		AECC8 (Functional Language)	1	0	0	1	1
Total Credit:24							

5th Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT012C501	Numerical Methods	3	1	0	4	1
2	MAT012C502	Number Theory and Graph Theory	3	1	0	4	1
Discipline Specific (DSE) (Any two-one from each group)							
3	MAT012D501	Advanced Linear Algebra	3	1	0	4	1
	MAT012D502	Hydrostatics	3	1	0	4	1
4	MAT012D503	Transform Calculus (Laplace and Fourier)	3	1	0	4	1
	MAT012D504	Hydrodynamics and Tensor calculus	3	1	0	4	1
Value Addition Course (VAC)							
5	MAT012V501	VAC4	2	0	0	2	2
Ability Enhancement Course (AEC)							
6	CEN982A501	AECC9 (CEN5)	1	0	0	1	1
7		AECC10 (Environmental studies and Sustainable Development)	1	0	0	1	1
Internship							
8		Mandatory 6 weeks internship after 4th sem	0	0	12	6	6
Total Credit:26							

6th Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT012C601	Advanced calculus	3	1	0	4	4
2	MAT012C602	Metric Space and Topology	3	1	0	4	4
Discipline Specific (DSE) (Any three-one from each group)							
3	MAT012D601	Mathematical Logic & Combinatorics	3	1	0	4	4
	MAT012D602	Real Analysis-II	3	1	0	4	4
4	MAT012D603	Spherical Trigonometry and Astronomy	3	1	0	4	4
	MAT012D604	Data Analysis and Lab (Python)	2	0	4	4	6
5	MAT012D605	Linear programming problem	3	1	0	4	4
	MAT012D606	Discrete Mathematics	3	1	0	4	4
Skill Enhancement Course (SEC)							
6	MAT012S601	SEC4 (Mathematical editing tools Latex))	0	0	4	2	4
Value Addition Course (VAC)							
7	MAT012V601	VAC5	2	0	0	2	2
Ability Enhancement Course (AEC)							
8	CEN982A601	AECC11 (CEN6)	1	0	0	1	1
9		AECC12 (Human values & Gender Senitization)	1	0	0	1	1
Total Credit:26							

Legend: L: Lecture Class; T: Tutorial Class; P: Practical Class: C: Total Credits

SYLLABUS (1ST SEMESTER)

Subject Name: Calculus (Differential & Integral) **Subject Code: MAT012C101**
L-T-P-C: 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Objective: The objective of **Calculus (MAT02C101)** is to impart the fundamental concepts of calculus and to explain various real-life problems which can be solved by using calculus.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** different methods of finding higher order differential and integral calculus of various functions.	BT1
CO2	**Illustrate** various methods to find higher order differentiation and integration of various functions.	BT2
CO3	**Apply** differentiation to find extreme values of functions, Jacobian, physical properties of various transformations.	BT3
CO4	**Analyze** concepts of differential calculus and integral calculus theories and their applications to scientific problems.	BT4

Prerequisite:

- Basic concepts of function, limit, continuity, differentiability of single variable functions
- Basic differentiation of important functions (from 10+2 level).
- Basic integration of important functions (from 10+2 level).

Detailed Syllabus:

Modules	Topics / Course Contents	Periods
I	**Differentiation:** Successive differentiation, nth derivative of some standard functions and Leibnitz's theorem, function of several variables, limit and continuity of function of several variables, partial differentiation, partial derivatives of first and higher orders for functions of two and three variables, Euler's theorem on homogeneous functions, total derivatives.	12
II	**Application of differentiation:** Jacobian, maxima and minima of function of several variables (two and three variables only), Leibnitz's rule (differentiation under integral sign). Tangents and normal-angle of intersection of two curves, length of tangent, normal, derivative of arc-length, pedal equations, angle between radius vector and tangent, Asymptotes-definition and working rules for finding asymptotes (in case of Cartesian equations).	12

III	**Curvature and curve tracing:** Curvature-definition of curvature and radius of curvature (Cartesian and polar), formulae for radius of curvature, circle of curvature. Singular points, double points, cusp, node, conjugate point, multiple point, determination of multiple points of the curve $f(x, y) = 0$. Curve tracing—tracing of catenary, cissoid, asteroid, cycloid, folium of Descartes, cardioide, lemniscate.	12
IV	**Integration and its applications:** Integrals of the form $\int \frac{px+q}{\sqrt{ax^2+bx+c}}dx$, $\int (px+q)\sqrt{ax^2+bx+c}\,dx$, $\int \frac{dx}{(px+q)\sqrt{ax^2+bx+c}}$ Integration of rational functions of sin x and cos x.(review only) Reduction formulae for integration of some functions, Multiple integral (double, triple integral), Change of variables, change of order of integration, Area by double integral, Volume as double and triple integral, Improper integrals, Beta- Gamma function.	12
TOTAL		48

Text Book:

1. *Differential and Integral calculus;* Piskunov N.; Paperback edition; 2018; Aargon Press.

Reference Books:

1. Apostol Tom M.; *Calculus* Volume-1; Second edition; 1975; John Wiley and Sons.
2. Apostol Tom M.; *Calculus*, Volume-2; Second edition; 1975; John Wiley and Sons.
3. Ayres Frank , Jr., Mendalson Elliott; *Calculus*; 2013; (Schaum's Outlines), McGraw -Hill.

SYLLABUS (1ST SEMESTER)

Subject Name: Classical Algebra and Trigonometry		**Subject Code: MAT012C102**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Classical Algebra and Trigonometry** (**MAT012C102)** is to impart the fundamental concepts of classical algebra and trigonometry and to apply the results of classical algebra and trigonometry to any other field of mathematics for higher study.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** concept of classical and trigonometry.	BT1
CO2	**Understand** inequalities and different inequality theorems.	BT2
CO3	**Solve** different types of algebraic equations.	BT3
CO4	**Analyze** various aspects of trigonometric and logarithm functions.	BT4

Prerequisites:

- Concept of Classical Set theory.

Detailed Syllabus:

Modules	Topics/Course content	Periods
I	**Relations:** Review (Relations, Functions, Composition of functions, Invertible functions), Binary relation, Well ordering principle, Equivalence relation, congruence relation in integers, Equivalence class, Relation induced by a partition of a set, Fundamental theorem on Equivalence relation, Partial order relation, Chain, Hasse diagram of partially ordered set, Maximal, Minimal element, infimum, supremum.	12
II	**Inequalities:** Inequalities $AM \geq GM \geq HM$ and their generalizations, the theorem of weighted means, Cauchy Schwarz Inequality, Weirstrass' Inequalities, Extreme values of sum & product.	12
III	**Theory of equations:** Relation between the roots and coefficients of a general polynomial equation in one variable, Transformation of equations, Descarte's rule of signs, Strum's theorem (statement only), Symmetric functions of roots, Solution of cubic equation by Cardon's method, Solution of biquadratic equation by Ferrari's method.	12

IV	**De'Moivre's theorem and its applications:** De'Moivre's theorem, Expansion of cosx and sinx in positive integral powers of x, Logarithm of a complex number, Exponential and Trigonometric functions of a complex variable, Euler's expansion for cosine and sine, Inverse functions, Gregory's series and its variants.	12
Total		48

Text Books:

1. *Higher Algebra (classical)**;*** Mapa S.K.; 2014; Sarat Book House; Calcutta.
2. *Higher Algebra*; Hall H.S. and Knight S. R.; Paperback edition; 2016; Arihant Publications.
3. *Part II- Plane Trigonometry*; Loney S. L.; Paperba edition; 2016; G.K. Publication Private limited.

Reference Books:

1. *Higher Algebra*; Hall H.S. and Knight S. R.; Paperback edition; 2016; Arihant Publications.
2. Das and Mukherjee; *Higher Trigonometry*; 33rd edition; 1933, Dhur and Sons; Kolkata.
3. Das B. & Maiti S. R.; *Higher Algebra*; 16th edition; 2010; Asoke Prakasan; Calcutta.
4. Bernard, S. & Child, J.M.; *Higher Algebra*; 2000; Macmillan India Ltd; Delhi.

SYLLABUS (1st SEMESTER)

Subject Name: Differential Equations (ODE & PDE) **Subject Code: MAT012C103**
L-T-P-C: 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Objectives: The objective of **Differential Equations (MAT012C103)** is to introduce the fundamental concepts of ordinary and partial differential equations and to explain the methods to solve such equations.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the first order differential equations and learn to solve first order differential equations by using different standard methods.	BT1
CO2	**Understand** the second order linear differential equations and able to apply the methods to solve such equations.	BT2
CO3	**Apply** different standard methods to solve first order linear and non-linear partial differential equations.	BT3
CO4	**Analyze** second order partial differential equations and find it's solution by standard methods.	BT4

Prerequisites:

- Concept of Differential Calculus and Integral Calculus from HS (10+2) level.
- Concept of Ordinary Differential Equation from HS (10+2) level.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Equations of first order** Introduction to differential equations (origin, order and degree, formation, types of solution), Separation of variables, Homogeneous Equation and equation reducible to homogeneous form, Exact differential equation, Linear differential equations, Bernoulli's equation, Application of first order differential equations.	**12**
II	**Higher order linear differential equations** Linear equations with constant coefficients, Homogeneous (Cauchy-Euler) Equation, Equations reducible to homogeneous form, Method of variation of parameters, Method of undetermined coefficients.	**12**
III	**Linear and Non-linear partial differential equations of first order** Definition, order, degree and formation of PDE, solve by direct integration, Lagrange's method of solving First order linear PDE, Classification of first order PDE, Non-linear PDE, Charpit's method of solution, Standard forms of solution.	**12**
IV	**Linear partial differential equations with constant coefficients and Second order PDE**	**12**

	Homogeneous and non-homogeneous linear PDE with constant coefficients, Classification of second order PDE, Solution of second order PDE by Monge's method and Method of separation of variables.	
Total		**48**

Text Books:

1. *Differential Equations*, Ross S. L., 3rd Edition, 2007, Wiley India.
2. *Applied Partial Differential Equations*, Logan J. David, 3rd Edition, 2014, Springer Nature.

Reference Books:

1. Raisinghania M.D., *Ordinary and Partial Differential Equations*, 2017, S. Chand and Co., New Delhi.
2. Coddington E. A. and Levinson N., *Theory of Ordinary Differential Equations*, 1st Edn., 2017, Tata McGraw-Hill, New Delhi.
3. *Elements of partial differential equations*, Snedden Ian Naismith, Reprint, 2006, Dover Publications Inc.
4. **Tveito** Aslak**, Winther** Ragnar., *Introduction to partial differential equations: a computational approach*, Vol. 25, 2005, Springer-Verlag Berlin Heidelberg.

SEC-1 (1st Semester)		
Subject Name: Mathematics for Competitive Examinations		**Subject Code: MAT012S101**
L-T-P-C: 2-0-0-2	**Credit Units: 2**	**Scheme of Evaluation: T**

Objective: The objective of **Mathematics for Competitive Examinations** (**MAT012S101)** is to impart the problem quantitatively and use appropriate arithmetical methods to solve the problem and to prepare the students for competitive examinations.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the basic calculations for competitive examinations.	BT1
CO2	**Illustrate** the uses of ratio and proportions in complicated problems.	BT2
CO3	**Apply** the number system in various problems in the competitive examinations.	BT3
CO4	**Examine** different problem solving technique in the competitive examinations.	BT4

Prerequisites:

- No prerequisites.

Detail Syllabus:

Modules	Topics / Course Content	Periods
I	**Basic Calculations:** LCM and HCF, Percentage, Algebra, Averages, Heights and distances, Simple and Compound Interest, Simplification and Approximation.	**6**
II	**Alligations and mixtures:** Ratio, proportion, mixture, Discount, Partnerships, Profit and Loss, Speed, Distance, Problems on Age, Boat Problems, Time and Work, Problems on Train, Work and Wages.	**6**
III	**Number System:** Fractions, Decimals, Number Series, Sets and Venn Diagrams, Surds, Indices, Exponents, Powers, Progressions.	**6**
IV	**Mensuration:** Area, Surface area, Volumes, Pipes and Cisterns.	**6**
Total		**24**

Text Book:

1. Abhijit Guha, "*Quantitative Aptitude for Competitive Examinations*", 4th Edition.

Reference book:

1. *Quantitative Aptitude*, Dr. R.S. Aggarwal, S.Chand Publication, New Delhi.

SYLLABUS (1ST SEMESTER)

Subject Name: Mathematics-I		**Subject Code: MAT012G101**
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective: The objective of **Mathematics-I** (**MAT012G101)** is to develop fundamental concepts of differential calculus and integral calculus.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** higher order calculus, sequence and series and trigonometry.	BT1
CO2	**Understand** the method to find derivatives, integration, convergence of sequence and theories of trigonometry.	BT2
CO3	**Apply** sequence and series and capability to check convergence.	BT3
CO4	**Analyze** the concept of calculus and De Moivre's theorem.	BT4

Prerequisites:

- Basic concept of differential calculus, Integral calculus, matrices.

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Differential Calculus** Successive differentiation, standard results on nth order derivatives and Leibnitz's theorem, partial differentiation, partial derivatives of 1st and higher orders for functions of two and three variables. Euler's theorem on homogeneous functions.	**9**
II	**Integral calculus** Reduction formulae for integration of the following functions. $x^n e^{ax}$, $x^m \ sinnx$, $x^m \ cosnx, sin^n x, cos^n x$, $sin^p x \ c \ os^q x \ \ (p > 0, q > 0), tan^n \ x, \ sec^n x, \ cos^m x \ cos \ nx$	**9**
III	**Sequence and series** Sequence of real numbers, bounded, convergent and non-convergent sequences, uniqueness of the limit and boundness of a convergent sequence. Cauchy sequence, Cauchy's General Principle of convergence (Proof of the necessary part only) Subsequence's, convergence and Divergence of monotonic sequences. Algebraic operations of limit (statements of the theorems without proof).	**9**

IV	**Trigonometry** Geometrical representation of complex numbers – the Argand plane. Polar form of a complex number. Modulus, amplitude and their various properties. De Moivre's theorem. Expansion of $cosx$ and $sinx$ in positive integral powers of x. Exponential and Trigonometric function of a complex variable. Euler's expansion for cosine and sine. Gregory's series.	**9**
Total		**36**

Text Books:

1. *Mathematical Analysis*, Malik S.C. and Arora S., 2nd edition, 2017, New Age International (P)Limited.
2. *Schaums outline's Trigonometry*, Moyer Robert E.and Ayers Frank, 6th edition, 2017, McGraw-Hill Education.

Reference books:

1. Piskunov N,*Differential and Integral calculus*., Paperback edition, 2018; Aargon Press.
2. *Schaums outline's Calculus*, Ayers Frank and Mendelson Elliott, 6th edition, 2013, McGraw-Hill Education.
3. Loney S. L., *Part II- Plane Trigonometry*, Paperback edition, 2016, G.K. Publication Private limited.

SYLLABUS (Generic II)

Subject Name: Fundamentals of Mathematics		**Subject Code: MAT012G102**
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective: The objective of **Foundation of Mathematics** (**MAT012G102)** is to develop the fundamental concept of linear equation, calculus and Laplace's transform.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the definitions and formulae of linear algebra, calculus and Laplace transformation.	BT1
CO2	**Understand** the theories of linear algebra, calculus and Laplace transformation.	BT2
CO3	**Apply** the theories of linear algebra, calculus and Laplace transformation to solve related problems.	BT3
CO4	**Analyze** the theories of linear algebra, calculus and Laplace transformation.	BT4

Prerequisites:

- Basic concept of linear equations and functions.

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Minors and Co-factors, Adjoint of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Rank of a matrix. Normal and Echelon form.	**9**
II	**Differentiation**: Introductions, Derivative of a function, Rolle's theorem, Mean value theorem, Successive Differentiation, Maxima or minima of a function, Partial differentiation.	**9**
III	**Integration:** Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals.	**9**
IV	**Laplace Transform**: Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse	**9**

	Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations	
Total		**36**

Text Books:

1. Ayers Frank and Mendelson Elliott, *Schaums outline's Calculus*, , 6th edition, 2013, McGraw-Hill Education.
2. Spiegel M. R., *Schaums outline's of Laplace Transforms*, McGraw Hill Education, 2005.

Reference books:

1. Narayan S. & . Mittal P.K., *A Text Book of Matrices,* S Chand & Company, 2010.
2. Piskunov N , *Differential and Integral calculus*., Paperback edition, 2018; Aargon Press.
3. Vittal P. R.; *Analytical Geometry 2D and 3D*; Pearson Education; 2013 .
4. Goyal J K & Gupta K P, *Laplace And Fourier Transforms*, Pragati Prakashan, 2016.
4. Lipschutz Seymour , *Linear Algebra*, 2017, Tata McGraw-Hill publishing Co Ltd

SYLLABUS (2nd SEMESTER)

Subject Name: Vector Analysis and Linear Algebra		**Subject Code: MAT012C201**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objectives: The objective of **Vector Analysis and Linear Algebra (MAT012C201)** is to provide the fundamentals & concept of vector algebra, vector calculus and matrix algebra.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Remember** the definitions and formulae of vector calculus and linear algebra.,	BT1
CO2	**Understand** the theories of vector analysis and linear algebra.	BT2
CO3	**Apply** the theories of vector analysis and linear algebra to solve related problems.	BT3
CO4	**Analyze** the theories of vector analysis and linear algebra with examples.	BT4

Prerequisites:

- Position vector, collinear vectors, parallel vectors, coplanar vectors, unit vectors, modulus of a vector, rectangular resolution of a vector, vector addition, scalar product and vector product of two and three vectors
- Matrix addition and multiplication.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Vector Algebra:** Conditions for collinearity and coplanarity, Vector equations of line and Plane, Distance of a point from a line, length of perpendicular from a point to a plane, distance of a point from a plane, Equation of the line of intersection of two planes. Shortest distance between two skew lines.	12
II	**Vector Calculus:** Ordinary differentiation of vector functions, Partial derivatives, Vector differential operator, Properties & significance of gradient, divergence & curl, Laplacian, Level surface, Directional derivative. Line, Surface and volume integrals. Green's theorem (with proof) and applications. Stokes theorem, Gauss divergence theorem (without proof) and their applications.	12
III	**Matrix Algebra and Determinants:** Algebra of matrices/Identity, scalar, diagonal matrix and Trace/Transpose of a Matrix, Power Matrices, Invertible Matrices/ Special Matrices:	12

	Symmetric, Skew-symmetric Matrices, Idempotent, nilpotent and orthogonal Matrices / Complex Matrices, Hermitian and Skew-Hermitian Matrices, Unitary Matrices / Normal Matrices and Properties / square block matrices. Basic properties of determinants, Cofactors, minors, principal minors / Singular and non-singular matrices/Evaluation of determinants: Laplace expansion / Adjoint and its properties / Volume as a determinant.	
IV	**System of linear equations:** System of linear equations / Elementary row operations; pivots / Inverse of a matrix (Gauss-Jordan reduction), Cramer's rule, Rank of a matrix, Echelon matrices, Normal form/ consistency and inconsistency of the system (homogeneous and non-homogeneous) / solution using Gauss elimination and Gauss-Jordan elimination / LU Decomposition method.	12
Total		48

Text Books:

1. *Vector Analysis*; Spiegal Murrary, 2nd Edition, 2017; Tata McGraw Hill Education.
2. *Linear Algebra*, Hoffman Kenneth and Kunze Ray, 2015, PHI learning private limited.

Reference Books:

1. Narayana Shanti; *A Text Book of Vector Calculus;* 2003; S. Chand & Co., New Delhi.
2. Lipschutz Seymour, *Linear Algebra*, 2017, Tata McGraw-Hill publishing Co Ltd.
3. Friedberg, Insel, Spence, "*Linear Algebra",* 4th edition 2015, Pearson Education India.
4. Raisinghania M. D.; *Vector Analysis*; 2nd Edition; 2015; S. Chand And Co.
5. Tallack J.C; *Introduction to Vector Analysis*; 1st Edition; 2009; Cambridge University Press.

SYLLABUS (2nd SEMESTER)

Subject Name: Analytical Geometry		**Subject Code: MAT012C202**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Analytical Geometry (MAT012C202)** is to impart fundamental laws and formulas of coordinate geometry and to demonstrate the algebraic methods to study geometry and to make graphical representations of algebraic equations.

Prerequisites:

- Basic concepts (absolute value, graphing, distance formula), inclination and slope of a line, division of a line segment, analytic proofs of geometric theorems, relations, and functions.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the definitions and formulae of two- and three-dimensional geometry.	BT1
CO2	**Understand** the equation and geometry of two- and three-dimensional coordinate system.	BT2
CO3	**Apply** the theories of two- and three-dimensional coordinate geometry to solve related problems.	BT3
CO4	**Analyze** two- and three-dimensional coordinate geometry to sketch different geometrical shapes.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Transformation and Pair of Straight Lines:** Transformation of Rectangular axes, Invariants, Removal of the xy-term, Pair of straight lines: Condition that the general equation of second degree in two variables may represent two straight lines, Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$, and Angle bisector between pair of lines.	12
II	**General Equation of Second Degree:** General Equation of Second degree of two variables for conic section, Parabola, Ellipse, Hyperbola, Pole, and Pair of tangents.	12
III	**Three-dimensional Geometry-I:** Rectangular Cartesian Co-ordinates in space, Direction cosines and angle between two lines, Equation of Plane in General form, Intercept and Normal form, Plane passing through three points, and Angle between two Planes. Straight line in symmetrical form, Angle between two lines, Coplanar lines, and Skew lines.	12

IV	**Three-dimensional Geometry-II:** Sphere: Plane section of a sphere, Sphere through a given circle. Intersection of two spheres, Condition for orthogonality of two spheres, Cone, and Cylinder.	12
Total		48

Text Books:

1. *The Elements of Coordinate Geometry*; Loney S. L.; 6th Edition, 2016, Arihant Publication.

Reference Books

1. Bell R. J. T., *An Elementary Treatise on Co-ordinate Geometry*; 2018; Franklin Classics.
2. Askwith E. H.; *A Course of Pure Geometry*, 2018; Franklin Classics.
3. Vittal P. R.; *Analytical Geometry 2D and 3D*; 2013; Pearson Education.

SYLLABUS (2st SEMESTER)

Subject Name: Introduction to Data Science		**Subject Code: MAT012C203**
L-T-P-C: 2-0-4-4	**Credit Units: 3**	**Scheme of Evaluation: TP**

Objective: The objective of the course **Introduction to Data Science (MAT01C203)** is to impart the knowledge of data collection and to enable applying multiple techniques (summary statistics, tables, graphics) to handling univariate data using basic hands-on program with MS-EXCEL and TABLEAU.

Course Outcome:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** raw data efficiently.	BT1
CO2	**Classify** different types of data.	BT2
CO3	**Apply** Handle Excel and Tableau for handling data.	BT3
CO4	**Analyse** different types of data.	BT4

Prerequisite:

- Basic concepts of averages.
- Basic knowledge of Ms-Excel.

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Data Collection:** Concept of a statistical population and sample from a population; qualitative and quantitative data. Primary data, secondary data, questionnaire and schedule. Construction of tables with one or more factors of classification. Diagrammatic and Graphical representation of non-frequency data. Frequency distribution, cumulative frequency distribution and their graphical representation - histogram, frequency polygon and Ogive.	**12**
II.	**Data Handling-1:** Univariate data: Concepts of Central tendency or location, Mean, Median and Mode. Concept of Dispersion, range, Mean Deviation and Standard Deviation and their relative measures, Skewness, Kurtosis.	**12**
III.	**Data Handling-2:** Bivariate Data: Introduction to Correlation, Diagrammatic method and Mathematical methods of simple correlation, probable error, rank correlation for untied and tied ranks. Introduction to simple regression and prediction.	**12**

IV	**Hands-on Programme with MS-Excel and Tableau:** Construction of Frequency distribution and drawing of charts in MS-Excel, Mean Deviation and Standard Deviation, Data Cleaning, Correlation and Regression in Excel, Data collection from external source, from web in Excel and Tableau.	**12**
TOTAL		**48**

Text Books:

1. "*Fundamentals of Mathematical Statistics*"; Gupta S. C., Kapoor V. K.; 10th revised edition, 2014, Sultan Chand and Sons, New Delhi
   Sultan Chand & Sons Publishers.
2. "*Statistical Methods: An Introductory Text*"; Medhi. J; 2006; New Age International Publishers.

Reference Books:

1. Choudhury L; "*Introduction to Statistics*"; Vol 1 & 2, 2002, Kitap Ghar, Guwahati.
2. Saxena H C; "*Calculus of Finite Difference & Numerical Analysis*"; 2010; S. Chand.
3. Spiegel Murray R, Schiller John J, Srinivasan R. Alu; "*Schaum's outline: Probability and Statistics*"; 4th Edition; 2012; Mc Graw –Hill Education.
4. Hooda R P; "*Statistics for Business and Economics*"; 3rd Edition, Macmillan India Ltd.
5. Goon A.M., Gupta M.K. and Dasgupta B.; "*Fundamentals of Statistics* (Vol.2)"; 2001; World Press.

SYLLABUS (2st SEMESTER)

Subject name: Introduction to R (SEC-2) **Subject Code: MAT012S201**
L-T-P-C – 1-0-2-2 **Credit Units: 2** **Scheme of Evaluation: (TP)**

Course objectives:

The objective of the course **Introduction to R (MAT012S121)** is to impart statistical tool R for for analysis of data.

Course Outcome:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** basics of coding in R.	BT1
CO2	**Demonstrate** different objects of R.	BT2
CO3	**Apply** different operators used in R.	BT3
CO4	**Analyze** different types of data through R.	BT4

Prerequisites:

- Basic concepts of averages.
- Basic knowledge of Ms-Excel.

Modules	Topics (if applicable) & Course Contents	Periods
I	Introduction to R: Advantages of R platform, Disadvantages of R platform, Needs of R Environment, Installation of R, General Properties of R.	6
II	Writing in R console, Writing with quote and without quote, R-objects, Vectors, Lists, Matrices, Arrays, Factors, Data Frames.	6
III	Variables, variable assignment, Data type of variable, finding a variable, deleting a variable, operators-Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Miscellaneous Operators	6
IV	Decision-making statement- if, if…else, switch, loop, array, packages, data file, charts and graphs.	6
	Total	24

Text books:

1. Hands-on Programming with R, Garrett Grolemund, 1st Edition, 2014, Google book.

Reference Books:

1. Tattar, P., Ramaiah, S., Manjunath, B. (2018). A course in statistics with R. Wiley.

SYLLABUS (2nd SEMESTER)

Subject Name: Mathematics-II		**Subject Code: MAT012G201**
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective: The objective of **Mathematics-II** (**MAT012G201)** is to impart the concept of linear equations, differential equations, vector analysis and coordinate geometry.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** first order differential equation, coordinate geometry, linear algebra and vector analysis.	BT1
CO2	**Understand** the method to solve problems of differential equation, coordinate geometry, linear algebra and vector analysis.	BT2
CO3	**Apply** differential equation, coordinate geometry, linear algebra and vector analysis to solve related problems.	BT3
CO4	**Analyze** the concept of differential equation, coordinate geometry, linear algebra and vector analysis.	BT4

Prerequisites:

- Basic concept of differential equation, straight line, circles, matrices.

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Theory of equations:** Relation between the roots and coefficients of a general polynomial equation in one variable, Transformation of equations, Descarte's rule of signs, Symmetric functions of roots, Solution of cubic equation by Cardon's method.	**9**
II	**Linear algebra** Adjoint and inverse of a matrix, symmetric and skew-symmetric matrices, hermitian and skew-hermitian matrices, rank of a matrix, rank of a matrix using elementary transformations, echelon form. Vector spaces, subspace of vector spaces, Linear combinations, Linear dependence and independence, Characteristic polynomial, eigenvalues and eigenvectors, Cayley-Hamilton Theorem.	**9**

III	**Ordinary Differential equations** Ordinary Differential Equations of first order and first degree, solution by variable separable method, Homogeneous equations, Linear equations and equations reducible to linear forms, Exact differential equations, Linear differential equation with constant coefficients. Homogeneous linear ordinary differential equations.	**9**
IV	**Coordinate Geometry** Transformation of coordinates, General equation of second degree and the conditions for representing a pair of straight lines, a parabola, an ellipse and a hyperbola, the equation of tangent, condition of tangency of a line, centre and reduction to standard forms.	**9**
Total		**36**

Text Books:

1. *Linear Algebra*, Lipschutz Seymour , *Linear Algebra*, 2017, Tata McGraw-Hill publishing Co Ltd.
2. *Schaums outline's Differential Equation*, Richard Bronson, 4th edition, 2014, McGraw-Hill Education.
3. *Vector Calculus* , Narayan Shanti and Mittal P.K., 1987, S. Chand.
4. *Analytical Geometry of two and three dimension and vector analysis*, Khan R.M., 2013, New Central Book Agency (P) Limited.

Reference Books:

1. Hoffman Kenneth and Kunze Ray, *Linear Algebra*, 2015, PHI learning private limited.
2. Raisinghania M.D., *Ordinary and Partial Differential Equations*, 2017, S. Chand and Co., New Delhi.
3. Vittal P. R.; *Analytical Geometry 2D and 3D*; 2013; Pearson Education.

SYLLABUS (Generic II)

Subject Name**: Aptitude and Quantitative Ability** Subject Code**: MAT012G202**
L-T-P-C: 3-0-0-3 Credit Units 3 Scheme of Evaluation: T

Objective: The objectives of **Aptitude and Quantitative Ability** (**MAT012G104)** is to impart the problem quantitatively and use appropriate arithmetical, and/or statistical methods to solve the problem to prepare the students for competitive examinations.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Choose** calculations technique to solve problems of competitive examinations.	BT1
CO2	**Explain** the logical reasoning.	BT2
CO3	**Apply** short cut technique to save time in solving problems.	BT3
CO4	**Compare** different data handling technique.	BT4

Prerequisites:

- Basic concept of school level Mathematics.

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Reasoning:** Letter series, number series, coding, decoding, Jumbled series, pictorial puzzles	**9**
II	**Logical Reasoning** Puzzle, Tabulation, Syllogism, Blood Relations, Family tree, Direction sense	**9**
III	**Quantitative Ability** LCM and HCF, Percentages, Profit and Loss, Interest (Simple and Compound), Speed, Time and Distance; Time and Work; Averages; Ratio and Proportion, Number System, Algebra, Geometry/Mensuration, Venn diagrams Linear Equations; Quadratic Equations, Progressions, Binomial Theorem, Surds and Indices, Inequalities, Permutation and Combination, Probability, Functions, Set Theory, Co-ordinate Geometry.	**9**
IV	**Data Interpretation** Data Tables, Data charts, Bar diagrams & Charts including Simple, Stacked, Composite Bar charts, Pie charts, Graphs – Line X-Y Graphs, Data analysis and Data comparison	**9**
Total		**36**

Text Books:

1. Abhijit Guha, "*Quantitative Aptitude for Competitive Examinations*", 4th Edition.
2. Arun Sharma, "How to Prepare for Logical Reasoning for the CAT".

Reference books:

1. *Quantitative Aptitude*, Dr. R.S. Aggarwal, S.Chand Publication, New Delhi.
2. *A Modern Approach to Verbal & Non- Verbal Reasoning*, Dr. R.S. Agarwal , S.Chand Publication, New Delhi.

SYLLABUS (3rd SEMESTER)

Subject Name: Real Analysis-I		**Subject Code: MAT012C301**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Real Analysis (MAT012C301)** is to develop independent thinking and problem-solving skills in various analytical properties of the real number system.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the definitions and formulae of Real analysis.	BT1
CO2	**Understand** the theories of Real analysis.	BT2
CO3	**Apply** the theories of Real analysis to solve related problems.	BT3
CO4	**Analyze** the theories of Real analysis with examples.	BT4

Prerequisite:

- Concept of Set theory and Calculus from HS level.

Modules	Topics / Course Contents	Periods
I	**Real Number System** Algebraic properties of $\mathbb{R}$, Absolute value and the real line, bounded and unbounded sets, Supremum and infimum of subsets of $\mathbb{R}$, Completeness property of $\mathbb{R}$, Archimedean property, Dense property of rational numbers, Neighborhood of a point in $\mathbb{R}$, Open and closed sets in $\mathbb{R}$.	12
II	**Sequences and Series** Sequences and their limits, convergent sequence, limit theorem, monotonesequence, subsequences, Limit superior and limit inferior for bounded sequence, series, convergence of series, Cauchy criterion for series, comparison tests.	12
III	**Limits and continuity of functions** Cluster/Limit point, Limit of functions ($\epsilon - \delta$ approach), sequential criterion for limits, Divergence criterion, limit theorems, infinite limits, limits at infinity, Continuity, Algebra of continuous functions, the maximum-minimum theorem.	12

IV	**Uniform continuity of functions and Differentiation** Uniform continuity, Lipschitz function, Differentiability of functions, Algebra of differentiable functions, Rolle's theorem, Mean value theorem, intermediate value property of derivatives, L'Hospital's rules.	12
Total		48

Text Book:

1. *Introduction to Real Analysis*; Bartle, Robert G., Sherbert Donald R.; Fourth Edition; 2014;Wiley India Pvt. Ltd.
2. *A Basic Course in Real Analysis*; Kumar, A. and Kumaresan, S.; Reprint 2016; CRC Press.

Reference Book:

1. *Mathematical Analysis*; Malik, S.C. and Arora Savita; Fifth edition; 2017; New Age ScienceLtd.
2. *Introduction to Analysis*, Mattuck, Arthur. ;1999; Prentice Hall.
3. *A Course in Calculus and Real Analysis*; Ghorpade, Sudhir R. & Limaye, B. V.; 2006; Undergraduate Texts in Mathematics, Springer (SIE).
4. *Principles of Mathematical Analysis*; Rudin Walter; Third Edition; 2017; McGraw HillEducation.
5. *Basic Real Analysis*; Sohrab, Houshang H.; Second Edition; 2014; Birkhauser.
6. *Elementary Analysis: The Theory of Calculus*; Ross, Kenneth A.; Second Edition; 2013; Springer.

SYLLABUS (3rd SEMESTER)

Subject Name: Mechanics-I		**Subject Code: MAT012C302**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Mechanics-I** (**MAT012C302**) is to impart the principles of static equilibrium to particles and rigid bodies.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** terms related to statics and dynamics.	BT1
CO2	**Understand** the laws different laws of statics and dynamics.	BT2
CO3	**Apply** different laws of statics and dynamics to solve related problems	BT3
CO4	**Examine** theories of statics and dynamics to solve real field problems.	BT4

Prerequisites:

- Concept of Vector Analysis, Differential Calculus and Integral Calculus.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Forces and Centre of gravity** Composition and Resolution of forces, Equilibrium of con- current forces, Parallel forces, Moment of a force, Couple, System of coplanar forces and conditions of equilibrium, Centre of gravity of plane curves and areas.	**12**
II	**Friction and Machines** Friction, laws of friction, Cone of friction, Angle of friction, Limiting friction, Equilibrium of a particle on a rough inclined plane, Machines, Mechanical advantage, Velocity ratio.	**12**
III	**Velocity, Acceleration and Motion** Components of velocity and acceleration along radial and transverse direction and along tangential and normal directions, Angular velocity and its relation with linear velocity, rectilinear motion, Simple harmonic motion.	**12**
IV	**Projectile and Impulsive forces** Motion of a Projectile, range on an inclined plane, Impulse, impulsive forces, work and energy, conservation of linear momentum and conservation of energy, Impact of elastic bodies (direct impact only).	**12**
Total		**48**

Text Books:

1. *Statics,* Das B.C. and Mukherjee B.N., 27th Edition, Reprint 2017, U N Dhar and Sons Private Ltd., Kolkata.
2. *Analytical Dynamics,* Das B.C. and Mukherjee B.N., 27th Edition, Reprint 2017, U N Dhar and Sons Private Ltd., Kolkata.

Reference Books:

1. Loney S. L., *The elements of Statics and Dynamics,* Part 1, Statics, 2016, Arihant Publication.
2. Loney S. L., *The elements of Statics and Dynamics,* Part 2, Dynamics, 2016, Arihant Publication.
3. Ray M. and Sharma G. C., *A text book on Dynamics*, Reprint, 2005, S Chand and Company.

SYLLABUS (3rd SEMESTER)

Subject Name: Ordinary Differential Equations		**Subject Code: MAT012D301**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objectives: The objective of **Ordinary Differential Equations** (**MAT012D301)** is to understand different forms of first ordinary differential equations, their solution methods and application to physical problems.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** different terms and definitions related to ordinary differential equations and identify different solution methods for ODE.	BT1
CO2	**Understand** the different methos of first and higher order differential equations.	BT2
CO3	**Apply** different methods to solve related problems of ordinary differential equations.	BT3
CO4	**Analyze** the solution of differential equations relating to physical or real-life problems.	BT4

Prerequisites:

- Concept of Differential Calculus and Integral Calculus from HS (10+2) level.
- Concept of Ordinary Differential Equation from HS (10+2) level.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Equations of first order** Exact differential equations, Integrating factor, Equations reducible to exact differential equation, Linear differential equations and equations reducible to linear form, Bernoulli's equation, Equation solvable for $\frac{dy}{dx}$, x, y, Clairaut's equation.	12
II	**Higher order homogeneous and non-homogeneous linear differential equations** Linear equations with constant coefficients, Homogeneous (Cauchy-Euler) Equation, Equations reducible to homogeneous form, Method of operators, Linear dependence and independence of solutions, Wronskian and its properties.	12
III	**Simultaneous and total differential equations**	12

	Ordinary simultaneous differential equations, working rules for solving simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, total differential equations, condition for integrability, condition for exactness and methods of solution.	
IV	**Application of ODE** Trajectory, orthogonal trajectories in cartesian and polar coordinates, population dynamics, chemical reaction, equation of motion.	12
Total		48

Text Book:

1. *Differential Equations*, Ross S. L., 3rd Edition, 2007, Wiley India.

Reference Books:

1. Raisinghania M.D., *Ordinary and Partial Differential Equations*, 19th edition, 2017, S. Chand and Co., New Delhi.
2. Coddington E. A. and Levinson N., *Theory of Ordinary Differential Equations*, Indian Edition., 2017 , Tata McGraw-Hill, New Delhi.
3. Ayers Jr Frank, *Schaum's Outline Series of Theory and problems of differential equations* , Reprint, 1989, Tata McGraw-Hill, New Delhi.
4. F. Brauer F. and Nohel J. A., *The Qualitative Theory of Ordinary Differential Equations: An Introduction*, New edition, 1999, Dover Publications Inc.

SYLLABUS (3rd SEMESTER)

Subject Name: Business Mathematics		**Subject Code: MAT012D302**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: TP**

Objective: The objective of the course **Business Mathematics (MAT01D302)** is to impart the concept of commercial and financial mathematics.

Course Outcome:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** different mathematical terms related to commercial and financial mathematics.	BT1
CO2	**Understand** the concept of commercial arithmetic and finance.	BT2
CO3	**Apply** the concept of commercial arithmetic and finance to solve related problems.	BT3
CO4	**Analyze** the different problems of business and economics through the commercial arithmetic and mathematics of finance	BT4

Prerequisite:

- Basic concepts of rates, ratios and percentages.
- Basic knowledge of co-ordinate geometry.
- Basic knowledge of differential calculus.
- Basic knowledge of integral calculus.

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Commercial Arithmetic-1:** Discount, Commission, Brokerage, Insurance, Rates and Taxes.	**12**
II.	**Commercial Arithmetic-1I:** Partnership, Bills of Exchange, Stock and Shares, Debenture.	**12**
III.	**Mathematics of Finance-1:** Interest, Annuity, types of annuity, immediate annuity, annuity due, deferred annuity, amount of an annuity, present value of an annuity.	**12**
IV	**Mathematics of Finance-II:** Equation of straight lines, General equation of a straight line, application straight lines in business and economics. Application of differential calculus in business and economics. Application of integral calculus in business and economics. Application of matrices in business and economics	**12**
TOTAL		**48**

Text Books:

1. "*A Textbook of Business Mathematics*";
   Hazarika P. L.; Revised edition, 2014, S. Chand & Company Ltd, New Delhi-110055.
2. "An Introduction to Business Mathematics"; Sundareshan, 2018, V., S. Chand & Company Ltd, New Delhi-110055.

Reference Books:

1. Baruah S; "Basic Mathematics and its Application in Economics"; 2nd Edition, 2012, Trinity Press Pvt Ltd, GOLDEN HOUSE, Daryaganj, New Delhi, Delhi 110002.
2. Trivedi K, Trivedi C; "*Business Mathematics*"; 1st Edition, 2020, Pearson, New Delhi-110017.

SYLLABUS (3rd SEMESTER)

Subject Name: Mathematics-III		**Subject Code: MAT012G301**
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective: The objective of **Mathematics-III (MAT012G301)** is to impart the concept Partial Differential equations, Algebra, three-dimensional geometry and vector integration.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** different terms of first order partial differential equations, algebra, solid geometry and vector integration.	BT1
CO2	**Understand** the different terms and rules of first order partial differential equations, algebra, solid geometry and vector integration	BT2
CO3	**Apply** the theories of partial differential equations, algebra, solid geometry and vector integration to solve related problems.	BT3
CO4	**Analyze** the concept of partial differential equations, algebra, solid geometry and vector integration in some real-life problems.	BT4

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**Partial Differential equations** Order, degree and formation of PDE, Solve by direct integration, Linear PDE, Lagrange linear equation and its solution, Non-linear PDE, Charpit's method and standard forms of solution. Homogenous and non-homogeneous linear PDE with constant co-efficient.	**9**
II	**Algebra** Binary composition, Algebraic Structure, Group, Subgroup, Coset, Normal Subgroup, Cyclic Group, Permutation Group, Quotient Group, Ring, Integral Domain, Division Ring, Field.	**9**
III	**Solid Geometry** Plane, Straight Line and Shortest Distance, Sphere, Cone and Cylinder.	**9**
IV	**Vector Integration** Differentiation of vector point function. Partial derivatives of vectors, direction derivatives, Grade, Divergence, Curl and identities (Cartesian co-ordinates only). Line integral, Surface Integral, Volume Integral, Divergence Theorem of Gauss, Stokes' Theorem, Green's theorem (without proof).	**9**
Total		**36**

Text Books:

1. *Ordinary and Partial Differential Equations*, Raisinghannia M.D., Reprint 2017, S. Chand and Co., New Delhi.
2. *Analytical Geometry of two and three dimension and vector analysis* , Khan R.M., 2013, New Central Book Agency (P) Limited.
3. *Modern Algebra*, Singh Surajeet and Zameeruddin Qazi, Eighth Edition, 2006, Vikash Publishing House Pvt Ltd.
4. *Vector Analysis*, Spiegel. Murray R. Lipschutz Seymour, Spellman Dennis, second edition, 2017, Mc Graw Hill Education.

Reference Books:

1. Logan J. David, *Applied Partial Differential Equations*, 3rd Edition, 2014, Springer Nature.
2. **Tveito** Aslak, **Winther** Ragnar.**,** *Introduction to partial differential equations: a computational approach*, Vol. 25, 2005, Springer-Verlag Berlin Heidelberg.
3. Narayan Shanti, Mittal P.K., *A text book of Vector Calculus*, 4th revised edition, 1987, S. Chand.

SYLLABUS (4th SEMESTER)

Subject Name: Abstract Algebra		**Subject Code: MAT012C401**
L-T-P-C: 3-2-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Abstract Algebra** (**MAT012C401)** is to provide the concept of algebraic structures and their applications.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the definitions and formulae of Abstract Algebra.	BT1
CO2	**Understand** the theories of Abstract Algebra.	BT2
CO3	**Apply** the theories of Abstract Algebra.to solve related problems.	BT3
CO4	**Examine** the theories of Abstract Algebra with examples.	BT4

Prerequisites:

- Knowledge of set theory

Detailed Syllabus:

Modules	Topics/Course content	Periods
I	Relations and Mappings: Binary relation, Equivalence relation, Equivalence class, Partial order relation, Mappings, Inverse mappings, Composition of mappings, Binary operations.	12
II	Group theory I: Concept of algebraic structure, Semigroup, Group, Abelian Group, Order of a group, Subgroups, Cosets, Lagrange's theorem, Index of a subgroup, Order of an element of a group, Cyclic groups, Maximal normal subgroups, Permutation, Cycle, Transposition, Product of disjoint cycles, Even and odd permutations, Permutation Group, Symmetric group, Alternating Group.	12
III	Group theory II: Normal sub-groups of a Group, Quotient Group, Homomorphism, Kernel of a Homomorphism and Fundamental theorem of Homomorphism, Isomorphism of Groups. First, Second and Third isomorphism theorems, Cayley's theorem, Centralizer, Normalizer, Center of a group.	12

IV	Ring theory: Rings, Unitary and commutative rings. Sub-ring Divisors of zero, Integral domain, Field, sub-field, Characteristic of a ring, Ideals, Ideal generated by a subset of a ring, Operations on ideals, Prime and Maximal ideals.	12
Total		48

Text Books:

1. *Modern Algebra*; Singh Surajeet and Zameeruddin Qazi; Eighth Edition; 2006; Vikash Publishing House Pvt Ltd.
2. *Contemporary Abstract Algebra* ; Gallian J. A.; 8th edition; 2013; Cengage Publication.

Reference Books:

1. Malik D. S., Mordeson J.N., Sen M. K. ; *Fundamentals of Abstract Algebra* ; 1996; McGraw Hill Company.
2. *A course in Abstract Algebra,* V.K. Khanna, S.K. Bhamri, Vikash Publishing House Pvt Ltd.
3. I. N. *Herstein*; *Topics in Algebra*; 2nd edition; 2006; John *Wiley* & Sons; New York.
4. Fraleigh John B.; *A First Course in Abstract Algebra*; 7th edition; 2013; Pearson Education India.
5. Dummit D. and Foote R.; *Abstract Algebra*; 3rd edition; 2011; *Wiley*; New York.
6. Jacobson, N.*; I & II Basic Algebra*; Second edition; 2009; Hindusthan Publishing Corporation, India.

SYLLABUS (4th SEMESTER)

Subject Name: Complex Analysis		**Subject Code: MAT012C402**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Complex Analysis** (**MAT012C402)** is **t**o provide the fundamental concepts of complex analysis.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the different terms of complex number system.	BT1
CO2	**Understand** the theories of complex analysis.	BT2
CO3	**Apply** the theories of complex analysis to solve related problems.	BT3
CO4	**Analyze** different theories of complex analysis.	BT4

Prerequisites:

- Concept of real number system and calculus in the set of real numbers.

Detailed Syllabus:

Modules	Topics /Course content	Periods
I	**Complex Numbers:** The Complex number system, Fundamental operations with complex numbers, Vector representation of complex coordinates, Absolute value and conjugate coordinates with properties, Triangle inequality, Axiomatic Foundations of the complex number system, Graphical representation of complex numbers, Polar form of complex numbers, De Moivre's Theorem, Roots of Complex numbers, Stereographic Projection, Dot and Cross product, Point sets and regions in complex plane, Extended complex plane .	12
II	**Functions , Limits and Continuity:** Variables and functions, Single and multiple valued functions, Inverse functions, Transformations, Curvilinear coordinates, Branch points and branch lines, Riemann surfaces, limits, Theorems on limits, Infinity, Continuity, Theorems on continuity, Uniform continuity, Sequences, Limit of a sequence, Infinite series.	12

III	**Complex Differentiation:** Differentiability, Analytic function, Cauchy Riemann Equations, Polar form of Cauchy Riemann Equations, Harmonic Functions, Harmonic conjugates, Geometric representation of derivative, Higher order derivatives, L'Hospital's Rule, Singularities, Construction of Analytic function, Orthogonal system	12
IV	**Elementary functions and definite integrals:** Elementary functions, Periodic functions, Zero of a function, Exponential Function, Trigonometric functions, Hyperbolic functions, Branches, Branch point, Branch line, Logarithimic function, Complex exponents, inverse trigonometric functions, Inverse hyperbolic functions, Definite integrals of functions, Contours, Contour integrals and its examples, Moduli of contour integrals.	12
Total		48

Text Books:

1. *Complex Variables and Applications;* Churchill R.V. and Brown J.W.; 8th edition; 2017; McGraw Hill Education.
2. *Schaum's Outline of Complex Variables*; Spiegel M.R.; 2edition; 2017; McGraw-Hill.

Reference Books:

1. Ahlfors L. V.; *Complex Analysis*; 3nd Edition; 2000; McGraw-Hill.
2. D. Sarason; *Complex Function Theory*; 2008; Hindustan Book Agency, Delhi.
3. Rudin, W.; *Real and Complex Analysis*; 3rd edition; 2017; McGraw-Hill.
4. Conway J. B.; *Functions of one complex variable;* Springer International Student edition; 2012; Narosa Publishing House, New Delhi.
5. ITL ESL Research and Development wing; *Complex analysis; 2012;* Pearson Education, New Delhi

SYLLABUS (4th SEMESTER)

Subject Name: Partial Differential Equations		**Subject Code: MAT012D401**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Partial Differential Equations** (**MAT012C301**) is to develop the concepts of different forms of partial differential equations, their solution methods and application to physical problems.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** different terms and definitions related to partial differential equations and identify different solution methods for PDE.	BT1
CO2	**Understand** the different methos of first and higher order partial differential equations.	BT2
CO3	**Apply** tdifferent methods to solve related problems of partial differential equations.	BT3
CO4	**Analyse** the solution of partial differential equations relating to physical or real-life problems.	BT4

Prerequisites:

- Concept of Differential Calculus and Integral Calculus.
- Concept of Ordinary differential equations.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Linear partial differential equations of first order** Introduction to first order PDE, solution by direct integration, Lagrange's method of solving First order linear PDE, Integral surfaces passing through a given curve, Surfaces orthogonal to a given system of curves.	**12**
II	**Non-linear partial differential equations of first order** Charpit's methods of solving first order but of any degree PDE, Standard forms of solution, Complete integral, particular integral, singular integral and general integral for solution of non-linear PDE, Jocobi's method of solving PDE with three independent variables.	**12**

III	**Linear partial differential equations with constant coefficients** Homogeneous and non-homogeneous linear PDE with constant coefficients, equations reducible to linear equations with constant coefficients, solution under given geometrical conditions	**12**
IV	**Second order partial differential equations** Solution of PDE of order two with variable coefficients, Laplace's transformation (Canonical forms), Monge's method, Method of separation of variables for Laplace equations, Heat equations, Wave equations	**12**
Total		**48**

Text Book:

1. *Elements of partial differential equations*, Snedden Ian Naismith, Reprint, 2006, Dover Publications Inc.

2. *Ordinary and Partial Differential Equations*, Raisinghania M.D., 19th Edition, 2017, S. Chand & Company Ltd.

Reference Books:

1. Logan J. David, *Applied Partial Differential Equations*, 3rd Edition, 2014, Springer Nature.
2. Tveito Aslak, Winther Ragnar., *Introduction to partial differential equations: a computational approach*, Vol. 25, 2005, Springer-Verlag Berlin Heidelberg.

SYLLABUS (4th SEMESTER)

Subject Name: Mechanics-II		**Subject Code: MAT012D402**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Mechanics-II** (**MAT012D402**) is to impart the principles of static equilibrium to particles and rigid bodies.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the terms related to rigid dynamics.	BT1
CO2	**Understand** the motion of the centre of inertia.	BT2
CO3	**Apply** different laws of rigid dynamics to solve related problems	BT3
CO4	**Examine** theories of rigid dynamics to solve real field problems.	BT4

Prerequisites:

- Concept of Vector Analysis, Differential Calculus and Integral Calculus.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	Moment of inertia and radius of gyration, Perpendicular axis theorem on moment of inertia, Moment of inertia of few simple bodies, Parallel axis theorem on moment of inertia, Product of inertia, theorem of six constants.	**12**
II	D'Alembert's principle, the general equation of motion of a rigid body, motion of the centre of inertia and motion relative to the centre of inertia.	**12**
III	Motion about a fixed axis, the compound pendulum, centre of percussion. Motion of a body in two dimensions under finite and impulsive forces.	**12**
IV	Conservation of momentum and energy, generalized coordinates, Lagrange's equations, initial motions.	**12**
Total		**48**

Text Books:

1. Loney, S. L., An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, (AITBS Publishers, 2016).

Reference Books:

1. Ray M. and Sharma G. C., *A text book on Dynamics*, Reprint, 2005, S Chand and Company.
2. Spiegel, M. R., Schaum's Outline of Theory and Problems of Theoretical Mechanics: with an Introduction to Lagrange's Equations and Hamiltonian Theory (McGraw-Hill, 2007).
3. Ramsey, A. T., Dynamics, 2nd Edition (The University Press, 2007).

SYLLABUS (4th SEMESTER)

Subject Name: Introduction to Mathematical Modelling		**Subject Code: MAT012D402**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The main objective of **Introduction to mathematical modelling (MAT012D402**) is to impart fundamental techniques of mathematical modelling and applications.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the terms required for mathematical modeling process.	BT1
CO2	**Understand** the concept and theories of Mathematical modeling.	BT2
CO3	**Apply** the different mathematical modeling techniques.	BT3
CO4	**Analyse** well-known mathematical models of real-world problems.	BT4

Prerequisites:

- Differential and Integral calculus
- Linear Algebra (linear systems of equations, Eigenvalues of a matrix)
- Differential equations.

Detailed Syllabus:

Modules	**Topics / Course content**	**Periods**
I	Introduction to Mathematical Modelling, need of mathematical modelling, Techniques of mathematical modelling, Classification and simple Illustrations. Mathematical modelling through differential equation Ordinary differential equations partial differential equations.	**12**
II	Mathematical Modelling Through Graphs. Mathematical modelling through functional integral delay, Differential and differential-difference equations.	**12**
III	Mathematical modeling through calculus of variations and dynamic programming, Mathematical modeling through mathematical programming.	**12**
IV	Maximum principle and minimum entropy principle. Multivariable optimization models, Computational methods for optimization models, Introduction to probability models, Stochastic models.	**12**
Total		**48**

Text Book:

1. *Mathematical Modeling*, J.N. Kapur , 2015, New Age International Publication (Re-print).

Reference Books:

1. Edward A. Bender: *An introduction to mathematical Modeling*, 2002, CRC Press.
2. Walter J. Meyer, *Concepts of Mathematical Modeling*, 2004, Dover Publ.
3. Mark M. Meerschaert, *Mathematical Modeling*, 2013, Academic Press,.

SYLLABUS (4th SEMESTER)

Subject Name: SEC3 (Mathematical programming tools) **Subject Code: MAT012S401**

L-T-P-C: 0-0-4-2 **Credit Units: 2** **Scheme of Evaluation: P**

Course Objectives:

The objective of **SEC3 (Mathematical programming tools) (MAT012S401)** is to familiarize students with the usage of mathematical software (Mathematica/MATLAB/Maxima/Maple).

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** basic terms relating to Mathematica/MATLAB/Maxima/Maple	BT1
CO2	**Demonstrate** different functions using codes of Mathematica/MATLAB/Maxima/Maple	BT2
CO3	**Apply** different codes of Mathematica/MATLAB/Maxima/Maple to find outputs.	BT3
CO4	**Compare** and conclude the output obtained by using Mathematica/MATLAB/ Maxima/ Maple.	BT4

Prerequisites:

- Knowledge of fundamentals of algebra, calculus and linear algebra.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Functions and Their Graphs:** Use of Mathematica as a calculator, Computing and plotting functions in 2D, Plotting functions of two variables using Plot3D function, Contour Plot, Plotting para metric curves surfaces using 'ParametricPlot3D' function, Customizing plots, Animating plots.	6
II	**Algebra and Calculus:** Factoring , Expanding and plot polynomials, Finding Roots of Polynomials with Solve and NSolve, Partial fractions using 'Apart', Solving Systems of Equations. Computing Limits, Derivative of a given function, Partial Derivative of a function, Finding higher Order Derivatives.	6

III	**Working with Matrices I:** Write Matrices and use of 'Matrix Form', Check dimensions of a given matrix, Matrix addition and multiplication, Transpose, Determinant, Inverse of a matrix.	6
IV	**Working with Matrices II:** Minors and cofactors, Working with large matrices**,** Performing Gauss elimination, Solving system of linear equations, Eigenvalue and Eigenvectors of a matrix, Rank and nullity of a matrix**.**	6
Total		24

Text Book:

1. Bruce F. Torrence, Eve A. Torrence, *The Student's Introduction to Mathematica ® A Handbook for Precalculus, Calculus, and Linear Algebra,* CUP.

Referencet Book:

1. Bindner, Donald & Erickson, Martin. (2011): *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.

SYLLABUS (4th SEMESTER)

Subject Name: Mathematics-IV		**Subject Code: MAT012G401**
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objectives: The objective of **Mathematics-IV** (**MAT012G401**) is to impart the concept of Probability, Analytic functions and numerical analysis.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** different terms of probability, analytic function and numerical analysis.	BT1
CO2	**Understand** the different terms and rules of probability, analytic function and numerical analysis.	BT2
CO3	**Apply** the theories to solve related problems of probability, analytic function and numerical analysis.	BT3
CO4	**Analyse** the theory of probability, analytic function and numerical analysis in some real-life problems.	BT4

Prerequisites:

- Knowledge of Permutation and combination
- Knowledge of Complex numbers
- Knowledge of differentiation and integration

Detailed syllabus:

Modules	Topics/course content	Periods
I	**Probability:** Probability, conditional probability, independence; Discrete random variables, Independent random variables, Expectation of Discrete Random Variables, Variance, Expectation of Continuous random variables, Binomial distribution, Poisson distribution, normal distribution, correlation coefficient.	**9**
II	**Analytic function:** Cauchy-Riemann equation, Harmonic functions, Complex integration, Cauchy's theorem, Cauchy's integral formula, Singularities, Residue.	**9**
III	**Numerical Methods-I:** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	**9**

IV	**Numerical Methods-II:** Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Numerical solution of ordinary differential equations: Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Predictor-corrector methods.	**9**
Total		**36**

Text Books:

1. Spiegel: Complex Variables, 2nd edition, 2017, Schaum Outline Series, McGraw Hill, New Delhi.
2. *An Introduction to Statistics*, L. Choudhury, Vol.1, 3rd edition, 2000, Kitapghar, Panbazar, Guwahati.

Reference books:

1. Gupta S.C. and Kapoor V.K., *Fundamentals of Mathematical Statistics,* , 10th revised edition, 2014, Sultan Chand and Sons, New Delhi.
2. H.C. Saxena: Finite Differences and Numerical Analysis, 11th edition, 2010, S.Chand & Company Ltd. New Delhi.
3. Kasana H.S., *Complex Variables-Theory and Applications*, Second edition. 2005, PHI Learning Private Limited.
4. Sastry S.S., *Introductory Methods of Numerical Analysis,*Fourth edition, 2005, PHI Learning Private Limited.

SYLLABUS (5th SEMESTER)

Subject Name: Numerical Methods		**Subject Code: MAT012C501**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The general objectives of the course **Numerical Methods (MAT012C501)** are to enable students solving algebraic, transcendental equations, numerical solutions of differential equation and Optimization Techniques.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**List** different types of error occurred in numerical analysis.	BT1
CO2	**Understand** the differences and difference formulas used to evaluate and approximate a function.	BT2
CO3	**Apply** appropriate numerical method to solve algebraic or transcendental equation.	BT3
CO4	**Analyze** the solution of first order differential equation obtained by numerical integration.	BT4

Prerequisites:

- Concepts of Matrices, Inequality and idea of Differential and Integral calculus.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Errors and Interpolation** Errors in arithmetic operations, different types of errors. Finite Difference operators and their operations on functions of a single variable, Relation between operators. Interpolation with equal intervals, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.	12
II	**Solution of polynomial and transcendental equations** Iteration method, Secant method, Bisection method, Newton-Raphson method and Regula-Falsi method. (Programming code of the methods)	12
III	**Numerical Differentiation and Integration** Numerical Differentiation, Numerical integration: General quadrature formula, Trapezoidal rule and Simpson's 1/3rd and 3/8 rules, Weddle's rule. (Programming code of the methods).	12
IV	**Numerical solution of ordinary differential equations**	12

	Taylor's series, Picard's method, Euler's methods, modified Euler methods, Runge-Kutta method, Finite Difference method. (Programming code of the methods).	
Total		48

Text Book:

1. *Introductory Methods of Numerical Analysis,* Sastry S. S, 5th edition, 2012, PHI Learning Private Limited.
2. *Linear Programming*, G. Hadley, 2002 (Reprint), Narosa publication house.

Reference Books :

1. Goyal B. S. and Mittal S. K., *Numerical Analysis*, 2015, Pragati Prakashan, Meerut.
2. H. C Saxena, *Finite difference and Numerical Analysis*., 2010, S Chand and Sons.
3. Jain M. K, Jain R. K. and Iyenger S.R.K, *Numerical Methods* (problem and solutions), 2004, New age Publishers.
4. Bali N. P. and Narayan Iyenger N, *A text book of Engineering Mathematics*, 9th edition, 2016, Laxmi Publication.
5. Hamdy A. Taha, "*Operations Research: An Introduction*", 8th Edition, 2008, Pearson Education.
6. R.K. Gupta, "*Linear programming*." 2011, Krishna Prakashan Media (p) Ltd.

E-Reference: **https://nptel.ac.in/courses/111/107/111107105/**

SYLLABUS (5th SEMESTER)

Subject Name: Number Theory and Graph theory		**Subject Code: MAT012C502**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Number Theory and Graph Theory (MAT012C502)** is to develop the basic understanding and problem-solving skills in Number Theory and Graph theory.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the definitions and properties of Well-ordering principle, Archimedean property, division algorithm, GCD and LCM, Euclidean algorithm and prime numbers.	BT1
CO2	**Understand** the theory of Congruence	BT2
CO3	**Apply** the theories and properties of various Graphs to solve related problems.	BT3
CO4	**Analyze** the theories of Trees and connectivity with examples.	BT4

Prerequisites:

- Basic concepts of number system and matrices.

Detailed Syllabus:

Modules	Topics / Course Contents	Periods
I	**Divisibility theory in the integers:** Well-ordering principle, Archimedean property, mathematical induction, division algorithm, greatest common divisor, relatively prime integers, least common multiple, Euclidean algorithm, prime numbers, properties of prime numbers, factorization in prime numbers, fundamental theorem of arithmetic.	12
II	**The theory of congruences:** Congruences, basic properties of congruence, residue classes, addition and multiplication of residue classes, linear congruences, the Chinese Remainder theorem, Fermat's theorem, Wilson's theorem.	12
III	**Introduction:** Definition of graph, undirected and directed graph, degrees and incidence of a vertex, handshaking theorem, isomorphism of graphs, Euler graphs, Hamiltonian paths and circuits, Weighted graph, Directed graphs-definition, types, directed paths and connectedness..	12

IV	**Trees and connectivity:** Definition and Properties of trees, rooted and binary trees, spanning trees, Kruskal's algorithm, Prim's algorithm, Connectivity, cut vertices, cut edges and blocks, Matrix representation of graphs- adjacency matrix and incidence matrix.	12
Total		48

Text Books:

1. *Elementary Number Theory*, Burton, D. M., 7th edition, 2011 (Reprint), McGraw-Hill Education
2. *Graph Theory*, Harary F., 1st Edition, 1994, West View Press.

Reference Books:

1. Hardy, G.H. and Wright, E. M., *An Introduction to the Theory of Numbers*; 6th edition, 2008, Oxford University Press.
2. *An introduction to number theory*, Ivan Nivam& H.S. Zuckerman, 5th Revised edition edition, 2008, John Wiley & Sons.
3. Telang, S. G., *Number Theory*, 2003, Tata McGraw-Hill, New Delhi.
4. *Basic Graph Theory*, Parthasarathy H. R., 1998, McGraw Hill Publishing.
5. Diestel. R., *Graph Theory (Graduate Texts in Mathematics)*, 5th edition, 2017, Springer.
6. Deo N., *Graph Theory with Applications to Engineering and Computer Science*, 1st Edition Reprint, 2016, Dover Publication.

SYLLABUS (5th SEMESTER)		
Subject Name: Advanced Linear Algebra		**Subject Code: MAT012D501**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Advanced Linear Algebra** (**MAT012D501)** is to impart various methods to solve system of linear equations and to learn fundamental concepts vector spaces and linear mapping on vector spaces.

Prerequisites:

- Basic concept of matrix and determinant.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the rank of a matric and solution of system of linear equations.	BT1
CO2	**Understand** the properties of eigenvalues, eigenvectors and linear mapping	BT2
CO3	**Apply** the theories of eigenvalues, eigenvectors and linear mapping	BT3
CO4	**Examine** the theories of bases, dimension and its application	BT4

Detailed Syllabus:

Modules	Topics / Course Content	Periods
I	**System of Linear Equations:** System of linear equations / Elementary row operations; pivots / Inverse of a matrix (Gauss-Jordan reduction), Echelon matrices, row reduction, row canonical form. Rank of a matrix, Normal form/ consistency and inconsistency of the system (homogeneous and non-homogeneous) / solution using Gauss elimination and Gauss-Jordan elimination / Gauss-Seidel Method / LU Decomposition, LU decomposition from Gaussian elimination / Cholesky Method.	12
II	**Eigenvalues and Eigenvectors:** Characteristic polynomial, Cayley-Hamilton Theorem, Verification of Cayley-Hamilton theorem, Eigenvalues and Eigenvectors, diagonalizing matrices, Minimal polynomial, further properties of eigenvalues and eigenvectors.	12
III	**Vector Spaces and Subspaces:**	12

	Vector spaces, subspace of vector spaces / Linear combinations, Linear spans/ sum and direct sum / Linear dependence and independence, Bases and dimension, Theorems on bases and dimension. .	
IV	**inear Mappings:** inear Mappings, Properties of Linear Mappings, kernel and image of linear mapping, computation of kernel and image of linear mappings, singular and non-singular linear mappings, isomorphism, Application to geometry and convex set. ector space of linear mappings, Invertible operators, Matrix representation of a linear operator with respect to a given basis.	12
	TOTAL	48

Text Books:

3. *Linear Algebra*, Hoffman Kenneth and Kunze Ray, 2015, PHI learning private limited.

Reference Books:

1. Lipschutz Seymour, *Linear Algebra*, 2017, Tata McGraw-Hill publishing Co Ltd.
2. Axler Sheldon, *Linear Algebra Done Right*, 2014, Springer Nature, Second edition.
3. Strang Gilbert, Linear Algebra and Its Applications, 4th Edition, 2007, Nelson Engineering.
4. Friedberg, Insel, Spence, "*Linear Algebra",* 4th edition 2015, Pearson Education India.

SYLLABUS (5th SEMESTER)

Subject Name: Hydrostatics		**Subject Code: MAT012D502**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objectives: The objectives of **Hydrostatics** (**MAT012D502)** are to develop fundamental understanding about hydrostatic law, principle of buoyancy and stability of a floating body for analysis of static fluids.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the terms related with hydrostatics and the involved equations and laws.	BT1
CO2	**Understand** the basic laws of hydrostatics, principle of buoyancy and stability of a floating body.	BT2
CO3	**Apply** basic laws and equations of hydrostatics to solve related problems.	BT3
CO4	**Analyze** stability of a floating body for static fluids.	BT4

Prerequisites:

- Concept of statics and mechanics.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Pressure equation**: Fluid pressure, Density and specific gravity, Differential equation of pressure, Condition of Equilibrium, Equi-pressure surface, Lines of force, Homogenous and Heterogeneous fluids, Elastic Fluids, Surface of equal pressure, Fluid at rest under action of gravity, Rotating fluids.	12
II	**Resultant Pressure and Centre of Pressure:** Resultant fluid pressure and related theorems, Centre of pressure, Determination of centre of pressure of parallelogram, triangle, circle under different conditions, Thrust on curved surfaces.	12
III	**Equilibrium and Stability of Floating bodies:**	12

	Condition of equilibrium of floating bodies, Curves of buoyancy, surface of buoyancy, Stability of equilibrium of floating bodies, Unstable and Neutral equilibrium, Meta center, Work done in producing a displacement, Vessel containing a liquid, Oscillation of floating bodies.	
IV	**Gases:** Gas law, Equation of state of a perfect gas, Mixture of gases, Internal energy, Adiabatic expansion, Work done in compressing a gas, Isothermal atmosphere, Connective equilibrium.	12
Total		48

Text Book:

1. *A Text Book of Hydrostatics*, Ray M and Sharma H.S., 2000 (Reprint), S. Chand & Company Ltd., New Delhi, India.

Reference Books:

2. Thomson M., *Theoretical Hydrodynamics, 2011,* Dover Publications Inc.
3. Sanyal D.C. and Das K., *Hydrostatics*, 2007, U. N. Dhur & Sons, Kolkata, India.

SYLLABUS (5th SEMESTER)

Subject Name: Transform Calculus (Laplace and Fourier) Subject Code: MAT012D503

L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: T

Objective: The objectives of **Fourier Series and Transform Calculus** (**MAT012D503)** is to provide exposure to solution of ordinary and partial differential equations of initial and boundary value problems by Laplace and Fourier transform methods.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** Laplace transforms, Inverse Laplace Transform, and its properties.	BT1
CO2	**Understand** about Fourier transform and its properties.	BT2
CO3	**Apply** the theories of Fourier Transform to understand Fourier Series.	BT3
CO4	**Analyse** the theory of Laplace and Fourier Transforms to solve initial and boundary value problems.	BT4

Prerequisites:

- Knowledge of Concept of Calculus, Ordinary Differential Equations and Partial Differential Equations.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	Laplace Transform: Laplace Transform of some elementary functions, Properties, Initial and Final Value Theorem, Laplace transforms of derivatives, Multiplication by positive integral powers of t and divison by t. Inverse Laplace Transform: Inverse Laplace transforms of of some elementary functions, Properties, Inverse Laplace transforms of derivatives, Multiplication by powers of s, Convolution property, Partial fraction method.	12
II	Fourier Series: Periodic functions, Euler's formulae, Convergence of the Fourier Series (Dirichlet's condition), the Main Theorem, Fourier Series for even and odd functions, Half Range Series, Fourier series for Discontinuous functions, Change of interval.	12

III	Fourier Transform: Fourier Integral Transform, Properties of Fourier Transform, Infinite Fourier sine and cosine transforms, Fourier Transform of Derivative of a function, Convolution Theorem, Perseval's Identity for Fourier transforms, Finite Fourier Transforms.	
IV	Application to differential equation: Solution of ordinary and partial differential equations of initial and boundary value problems by Laplace and Fourier transform methods.	12
Total		48

Text Books:

1. *Laplace and Fourier Transforms*, Goyal J. K. & Gupta K. P, Pragati Edition, 2016, Pragati Prakashan.
2. *Theory and Problem of Laplace Transform,* Spiegel M. R., Paperback edition, 2018, McGraw-Hill Book Company.

Reference Books:

1. Raisinghannia M.D., *Advanced Differential Equations*, 19th Edition, 2018 (Reprint), S. Chand and Co., New Delhi.
2. *Fourier Transforms*, Sneddon I. N., 2008, S. Chand and Co., New Delhi
3. Brown J. W. and Churchill R., *Fourier Series and Boundary Value Problems*, 8th Edition, 2015, McGraw Hill.
4. Dyke, P., *An introduction to Laplace Transforms and Fourier Series*, 2001, Springer London.
5. *Integral Transforms and Fourier Series*, Srivastava A.N and Ahmad M., 2011, Alpha Science Intl Ltd.

SYLLABUS (5th SEMESTER)

Subject Name: Hydrodynamics and Tensor Calculus		**Subject Code: MAT012D504**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objectives: The objectives of the course **Hydrodynamics and Tensor Calculus (MAT012D504)** are to develop basic concepts of fundamental laws of hydrodynamics and Tensor Calculus and to develop problem-solving skills to solve related problems.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the terms related with hydrodynamics and tensor calculus.	BT1
CO2	**Understand** the basic laws of hydrodynamics and the laws and properties related with tensor calculus.	BT2
CO3	**Apply** basic laws and properties of hydrodynamics and tensor to solve related problems.	BT3
CO4	**Analyze** the equation of motion for hydrodynamic problems.	BT4

Prerequisites:

- Concept of mechanics and hydrostatics.
- Concept of vector algebra and vector analysis.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Kinematics:** Real and ideal fluid, velocity of a fluid at a point, Eulerian and Lagrangian method, stream lines and path lines, steady and unsteady flows, velocity potential, rotational and irrotational motions, local and particle rate of change, acceleration of a fluid at a point.	**12**
II	**Equation of Motion:** Equation of continuity, Euler's equation of motion, Bernoulli's equation, steady motion under conservative forces, impulsive motion.	**12**
III	**Tensor Algebra:**	**12**

	Transformation of coordinates, Orthogonal Curvilinear Coordinates, Unit Vectors in Curvilinear System. Transformation laws of covariant and contravariant tensors, Mixed tensor, Rank of tensors, symmetric and anti-symmetric tensors and related theorems, Algebraic operations on tensors, contraction, Inner and outer product of tensors, Contraction, Quotient law.	
IV	**Riemannian Metric and Christoffel's Symbols:** Riemannian metric, Riemannian space, Definition of metric tensors, Fundamental covariant tensor, Length of a curve, unit tangent vector, projection of a vector along a direction, Gradient of a scalar function, angle between two vectors. Christoffel's brackets of first and second kinds, their properties, Transformation laws of Christoffel brackets.	**12**
Total		**48**

\Text Book:

1. *Fluid Dynamics*, Raisinghania M. D., 2010 (Reprint), S. Chand and Co., New Delhi.
2. *Tensor Calculus and Riemannian Geometry*, Agarwal D.C., 2014, Krishna Prakashan,.

Reference Books:

1. Schlichting H. translated by Kertin J, *Boundary Layer Theory*, 9th Edition, 2017, Springer
2. Charlton F., *Text book of Fluid Dynamics*, 2004, CBS Publishers and Distributors, New Delhi.
3. Goyal J. K. and Gupta K. P., *Tensor Calculus and Riemannian Geometry*, 2003, Pragati Prakashan meerut.
4. Kay D., *Schaums Outline of Tensor Calculus*, 2011, McGraw-Hill Education.

SYLLABUS (6th SEMESTER)

Subject Name: Advanced Calculus		**Subject Code: MAT012C601**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Advanced Calculus** (**MAT012C601)** to develop independent thinking in various analytical properties of the advance real number system.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** sequence and different comparison tests.	BT1
CO2	**Understand** the theory of Continuity and Differentiability.	BT2
CO3	**Apply** the theories to find out maxima and minima of functions of two variables.	BT3
CO4	**Analyse** Change of order of integration in double integrals.	BT4

Prerequisites:

- Concept of Set Theory and Calculus.

Detailed Syllabus:

Modules	Topics /Course content	Periods
I	Advanced Sequence: Definition of a sequence, Series of non-negative terms. Comparison tests, Cauchy's integral test, Ratio tests, Raabe's, Logarithmic, De Morgan and Bertrand's tests. Alternating series, Leibnitz's theorem. Absolute and conditional convergence.	12
II	Continuity and Differentiability: Continuity, Sequential continuity, Chain rule of differentiability, Mean value theorems and their geometrical interpretations. Darboux's intermediate value theorem for derivatives, Taylor's theorem with various forms of remainders.	12
III	Maxima and Minima: Envelopes, evolutes. Maxima, minima and saddle points of functions of two variables. Lagrange's multiplier method.	12
IV	Double and Triple Integration: Beta and Gamma functions, Double and triple integrals, Dirichlet's integrals, Change of order of integration in double integrals.	12
Total		48

Text Book:

1. *Introduction to Real Analysis*; Bartle, Robert G., Sherbert Donald R.; Fourth Edition; 2014;Wiley India Pvt. Ltd.
2. *A Basic Course in Real Analysis*; Kumar, A. and Kumaresan, S.; Reprint 2016; CRC Press.

Reference Book:

1. *Mathematical Analysis*; Malik, S.C. and Arora Savita; Fifth edition; 2017; New Age ScienceLtd.
2. *Principles of Mathematical Analysis*; Rudin Walter; Third Edition; 2017; McGraw HillEducation.
3. *Basic Real Analysis*; Sohrab, Houshang H.; Second Edition; 2014; Birkhauser.
4. *Elementary Analysis: The Theory of Calculus*; Ross, Kenneth A.; Second Edition; 2013; Springer.
5. *Introduction to Analysis*, Mattuck, Arthur. ;1999; Prentice Hall.
6. *A Course in Calculus and Real Analysis*; Ghorpade, Sudhir R. & Limaye, B. V.; 2006; Undergraduate Texts in Mathematics, Springer (SIE).

SYLLABUS (6th SEMESTER)

Subject Name: Metric Space and Topology		**Subject Code: MAT012C602**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The aim of the course **Metric Space and Topology (MAT012C602)** is to introduce the concepts and to explain the fundamental theory of metric and topological spaces, to enable learning the basic notions of metric and topological spaces and to impart the properties of continuous mappings.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl. No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** and understand the concept of metric spaces.	BT1
CO2	**Understand** the concept of sequences in metric spaces.	BT2
CO3	**Apply** the concept of continuity, compactness and connectedness in metric spaces to solve related problems.	BT3
CO4	**Analyze** the concept of topological spaces.	BT4

Prerequisites: Basic knowledge on calculus and set theory.

Detailed Syllabus:

Modules	Topics / Course Contents	Periods
I.	**Metric spaces:** Definition and examples, diameter of a set, bounded and unbounded metric spaces, open and closed balls, neighborhood, open set, interior of a set, Limit point of a set, closed set, closure, exterior, boundary of a set, dense and non-dense sets.	12
II.	**Sequences in metric space:** Cauchy sequences, complete metric spaces, cantor's intersection theorem, Baire Category theorem, completeness and contracting mappings, Banach's fixed point theorem.	12
III	**Continuity in metric spaces:** Continuity and uniform continuity in metric spaces, homeomorphism in metric spaces, Compactness and connectedness in metric spaces.	12

IV	**Topological Spaces:** Definition and examples of topological spaces, indiscrete topology, discrete topology, usual topology, cofinite topology, open and closed sets, neighborhoods, limit points, adherent points, derived sets, closure, interior and exterior of a set.	12
TOTAL		48

Text Books:

1. Simmons G.F., *Introduction to topology and modern analysis*, Indian Edition, 2017, McGraw Hill Education.
2. Sharma J. N., Mathematical Analysis-I 2014, Krishna Prakashan Mandir, Meerut.

Reference Books:

1. Malik S. C. and, Arrora S, *Mathematical Analysis*, 2017, New Age International Private Limited.
2. Lipschutz S., *General topology*, Schaum outline series, 2011, McGraw-Hill Education.
3. Kumaresan S., *Topology of Metric Spaces*, 2005, Alpha Science International Ltd, Harrow, UK.

SYLLABUS (6th SEMESTER)

Subject Name: Mathematical Logic & Combinatorics **Subject Code: MAT012D601**

L-T-P-C: 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Objective: The objectives of **Combinatorics & Mathematical Logic** (**MAT012D601**) is to formulate problems in the language of formal system, to use concept of mathematical logic in inference theory and to study basic idea of counting principle.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** basic connectives and formal system of statement calculus	BT1
CO2	**Understand** the basic concept of mathematical logic and combinatorics	BT2
CO3	**Apply** idea of mathematical logic and combinatorics to solve problems.	BT3
CO4	**Examine** theories of mathematical logic and combinatorics to solve problems of other branches.	BT4

Prerequisites: Set theory, permutation and combination.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Combinatorics** Pigeonhole Principle, Basic and Bijective counting, Compositions and Partitions, Advanced Counting, Inclusion Exclusion, Mobius Inversion, Generating Functions.	12
II	**Informal statement calculus** Propositional Connectives, Truth Tables, Tautologies, rules for manipulation and substitution, Normal forms, adequate sets of connectives, arguments and validity	12
III	**Formal Statement Calculus** Formal system L of statement calculus, Formal definitions of Proof, Theorem and Deduction, Deduction theorem and its converse, Hypothetical Syllogism, Theory of Inference, Truth table technique, rule of inference, Indirect method of proof.	12

IV	**Adequacy theorem for Logic** Valuation in Logic, tautology, the Soundness theorem, extensions of Logic, consistency of an extension, Informal Predicate Calculus, Predicates and Quantifiers, Inference theory of predicate calculus.	12
Total		48

Text Book:

1. *Logic for Mathematicians*; Hamilton A.G, 7th edition, 1991, Cambridge University Press.

Reference Books:

1. Elliot Mendelson, *Introduction to mathematical Logic*, Revised 6th Edition, 2015, Chapman and Hall.
2. Veerarajan T., *Discrete Mathematics with Graph Theory and Combinatorics*, 2007, McGraw Hill Education (India) Private Limited.
3. Enderton H.B., *A Mathematical Introduction to Logic*, 2nd edition, 2001, A Harcourt Science and Technology Company.

SYLLABUS (6th SEMESTER)

Subject Name: Real Analysis-II		**Subject Code: MAT012D602**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Real Analysis-II (MAT012D602)** is to understand the underlying concept of differentiability and its applications, the integration of bounded functions on a closed and bounded interval, the sequence and series of real valued functions, an important class of series of functions and to develop independent thinking and problem-solving skills.

Course Outcomes:

After successful completion of the course, student will be able to

Sl. No.	Course Outcome	Bloom's Taxonomy Level
CO1	**Define** and understand concepts of differentiability and its applications.	BT1
CO2	**Understand** concepts of differentiability and Taylor's theorem.	BT2
CO3	**Apply** the concept of Riemann integration.	BT3
CO4	**Analyze** the concept of sequences and series of functions.	BT4

Prerequisite: Concept of Real Analysis-I studied in 3rd Semester.

Detailed Syllabus:

Modules	Topics / Course Contents	Periods
I	**Mean Value Theorems and its Applications** Definition and types of intervals, Nested intervals property; Open and closed sets in $\mathbb{R}$; Neighborhood of a point in $\mathbb{R}$, adherent point, limit point, condensation point, isolated point, derived set; Interior point, exterior point, boundary point; Differentiability, Rolle's Theorem, Mean Value Theorems and its applications.	12
II	**Taylor's Theorem and its Applications** Taylor polynomial, Taylor's theorem with Lagrange form of remainder, Application of Taylor's theorem in error estimation; Relative extrema, and to establish a criterion for convexity; Taylor's series expansions of e^x, $\sin x$ and $cos\ x$.	12
III	**Riemann Integration** Definition of Riemann integration, Inequalities for upper and lower Darboux sums, Necessary and sufficient conditions for the Riemann integrability, Properties of Riemann integrable functions, intermediate value theorem for integrals, Fundamental theorems of calculus, and the integration by parts.	12

IV	**Sequence and Series of Functions** Pointwise and uniform convergence of sequence of functions, Theorem on the continuity of the limit function of a sequence of functions, Cauchy criterion sequence of functions, interchange of the limit and integrability of a sequence of functions. Pointwise and uniform convergence of series of functions, Derivability and integrability of the sum function of a series of functions, Cauchy criterion and the Weierstrass M-Test for uniform convergence.	12
To tal		48

Text Book:

1. *Introduction to Real Analysis*; Bartle, Robert G., Sherbert Donald R.; Fourth Edition; 2014;Wiley India Pvt. Ltd.
2. *A Basic Course in Real Analysis*; Kumar, A. and Kumaresan, S.; Reprint 2016; CRC Press.

Reference Book:

1. *Mathematical Analysis*; Malik, S.C. and Arora Savita; Fifth edition; 2017; New Age ScienceLtd.
2. *Principles of Mathematical Analysis*; Rudin Walter; Third Edition; 2017; McGraw HillEducation.
3. *Basic Real Analysis*; Sohrab, Houshang H.; Second Edition; 2014; Birkhauser.
4. *Elementary Analysis: The Theory of Calculus*; Ross, Kenneth A.; Second Edition; 2013; Springer.
5. Introduction to Analysis, Mattuck, Arthur. ;1999; Prentice Hall.
6. A Course in Calculus and Real Analysis; Ghorpade, Sudhir R. & Limaye, B. V.; 2006; Undergraduate Texts in Mathematics, Springer (SIE).

SYLLABUS (6th SEMESTER)

Subject Name: Spherical Trigonometry and Astronomy Subject Code: MAT012D603

L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: T

Objective: The objectives of **Spherical Trigonometry and Astronomy** (**MAT012D603**) are to provide the concept of trigonometry on spherical coordinate system, introduce the application of spherical trigonometry in astronomy. and enable learning Kepler's laws of planetary motion and its applications.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** spherical trigonometry, terrestrial sphere and celestial sphere.	BT1
CO2	**Understand** spherical trigonometry concept and position of heavenly bodies in terrestrial sphere and celestial sphere.	BT2
CO3	**Apply** the theories of spherical trigonometry to study Astronomy.	BT3
CO4	**Analyse** the theory of Astronomy, Kepler's planetary motion.	BT4

Prerequisites:

- Concept of trigonometry on Euclidean spaces.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Spherical Trigonometry:** Section of a sphere by a plane, spherical triangles, properties of spherical and polar triangles, fundamental formulae of spherical triangles, sine formula, cosine formula, sine cosine formula, cot formula, Napier's rule of circular parts.	**12**
II	**Celestial Sphere:** The standard(or geometric) celestial sphere, system of coordinates, conversion of one coordinate system to the another system, diurnal motion of heavenly bodies, sidereal time, solar time(mean), rising and setting of stars, circumpolar star, dip of the horizon, rate of change of zenith distance and azimuth, examples.	**12**
III	**Planetary motion and Refraction:** Planetary motion, Keplar's laws of planetary motion, deduction of Keplar's law from Newton's law of gravitation, the dynamical principle of orbital motion, the equation of the orbit, velocity of a planet in its orbit,	**12**

	components of linear velocity perpendicular to the radius vector and to the major axis. The orbital and synodic periods of a planet. Laws of refraction, refraction for small zenith distance, General formula for refraction, Cassini's hypothesis, differential equation for refraction, effect of refraction on sunrise, sunset, right ascension and declination, shape of the disc of the sun.	
IV	**Parallax:** The geoid, astronomical and geocentric latitude, Geocentric parallax, parallax of the moon, right ascension and declination, parallax on zenith distance and azimuth, stellar or annual parallax, effect of parallax on the star's longitude and latitude, effect of stellar parallax on right ascension and declination.	**12**
Total		**48**

Text Book:

1. *Text Book on Spherical Astronomy*, Smart W. M., 6th edition, 1977, Cambridge University Press.

Reference Books:

1. Dey K.K., *Text Book of Astronomy*, 1980, 1st Edition, Calcutta Book Syndicate.
2. Prasad G., *Text Book on Astronomy*; 8th edition 2014, Pothishala Pvt. Ltd.
3. Sharma S. K. and Gupta R.K., *Spherical Astronomy*, 2014, Krishna Pakashan Media (P) Ltd.
4. Malik G.S., *Spherical Astronomy*, 2005, Kedar Nath Ram Nath, Meerut.

SYLLABUS (6th SEMESTER)

Subject Name: Data Analysis and Lab (Python)		**Subject Code: MAT012D604**
L-T-P-C: 3-0-1-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The general objectives of the course **Data Analysis and Lab (Python) (MAT012D604)** are to enable learning basics of Python, handling Python for data wrangling, data analyzing and data prediction using Python.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Memorize** Python Basics, Data types and variables, Operators and operator precedence, Data type conversions, Control statements	BT1
CO2	**Discuss** Preparation of Datasets, Exploratory Data Analysis, Filtering and hierarchical indexing using Pandas.	BT2
CO3	**Apply** Python for Descriptive and Inferential Statistics.	BT3
CO4	**Analyze** data using machine learning techniques.	BT4

Prerequisites:

- Concepts of basic statistics.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Introduction to Python:** The application areas of Python, Download and install Python, Execute Python program from command prompt and using IDLE, Save programs with .py extension and execute it from prompt, Module: NumPy, Pandas, Matplotlib, Data types and variables, Operators and operator precedence, Data type conversions, Data input, Comments, If statement, If., elif., else statement, loop, For loop, Break & continue, String, List, Tuple, Dictionary, Set, Function, Define a function, Pass arguments.	12
II	**Preparation of Datasets:** Importing datasets, Python packages for data handling, Organization of data, Identify and Handle Missing Values, data cleaning, manipulation of data, data formatting, binning, Data wrangling, Web scrapping, Combing and merging data sets, Reshaping and pivoting, Data transformation. Exploratory Data Analysis, Filtering and hierarchical indexing using Pandas. Data Visualization: Basic Visualization Tools, Specialized Visualization Tools, Seaborn Creating and Plotting Maps.	12

III	**Descriptive and Inferential Statistics:** Summarization of data, Correlation, Testing of hypothesis, z-test for: single proportion, two proportions, single mean, two means, t-test for: single mean, two means, paired t-test, Analysis of variance: one-way and two-way ANOVA, testing of correlation coefficient.	12
IV	**Machine Learning technique:** Supervised learning, Unsupervised learning, Regression, simple linear regression, multiple linear regression, model evaluation using visualization, Polynomial Regression, Pipelines, Under-fitting, Over-fitting, Logistic Regression. Detection and prediction of data (Use available data sets).	12
Total		48

Text Book:

1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
2. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.

Reference Books :

1. Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc".
2. Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc".
3. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). "Wiley-Interscience Publication".
4. Jiawei Han and Micheline Kamber (2006). Data Mining: Concepts and Techniques. "

SYLLABUS (6th SEMESTER)

Subject Name: Linear Programming Problem (LPP)		**Subject Code: MAT012D605**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Linear Programming Problem (MAT012D605)** is to impart the fundamental concepts and application of Linear Programming Problem in real-life problems.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** different types of Linear Programming Problem.	BT1
CO2	**Explain** the methods of solution of different types of LPP	BT2
CO3	**Apply** the methods of solution to solve using simplex method, transportation, Assignment and game theory problems	BT3
CO4	**Analyse** the different cases that can arise during solution process such as concept of degeneracy, alternate Optima, infeasibility and boundedness of the solution.	BT4

Prerequisites:

- Basic concepts of Calculus and Linear algebra.

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	**Linear Programming**: Formulationof LPP, Graphical Method of solution,General LPP, Cannonical and standard form of LPP, Simplex Method, Artificial variable Techniques, Big M method, Two Phase method. Application of Simplex method.	12
II	**Transportation model**: Introduction to the model, Definition of transportation model, Matrix terminology, Formulation and solution of Transportation model, Variations in Transportation model, Post optimality analysis, dual of the transportation problem.	12
III	**Assignment model**: Definition of Assignment Problem, mathematical representation of the assignment problem, Comparison of assignment problem with transportation problem, The Hungarian method for solution of Assignment problem, Variation of assignment problem, The travelling Salesman problem.	12

IV	**Game theory**: Basic Concept and Terminologies, Two-person Zero-sum Game, and Game with Pure and Mixed Strategies, Dominance Principle, Arithmetic Method, and Graphical Method for Solving (2× n) Game, Graphical Method for Solving (m×2) Game and Solution of Game by Simplex Method	12
Total		48

Text book:

1. *Problems in Operations research (Principles and Solutions)*, Gupta P.K. and Hira D.S., Revised Edition, 2015, Sultan Chand and Sons New Delhi.

Reference books:

1. Rao S. S., *Optimization Theory and Applications*, 1979, Wiley Eastern Limited, New Delhi.
2. Bronson Richard and Naadimuthu Govindasami, Schaum's Outline of Operations Research, 2nd Edition, 2017,
3. Swarup Kanti, Gupta P.K. and Mohan M., *Operations Research*, 2014, Sultan Chand and Sons New Delhi.
4. Hadley G., *Linear programming*, 2002, Narosa Publishing House.
5. Hillier F.S. and.Lieberman G.J, *Introduction to operations Research*, 9th Edition, 2011, McGraw Hill International Edition.
6. Taha H.A, *Operations Research – In Introduction*, 9th Edition, 2014, Pearson Education India.

SYLLABUS (6th SEMESTER)

Subject Name: Random Processes **Subject Code: MAT012D606 L-T-P-C: 3-1-0-4** **Credit:4** **Scheme of Evaluation: T**

Objective: The objectives of **Random Processes (MAT012D606)** is to provide necessary basic concepts in probability and random processes for applications.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the concept Probability and distributions	BT1
CO2	**Understand** the concept of Random processes and application.	BT2
CO3	**Apply** the theory of random processes in appropriate field of study	BT3
CO4	**Analyze** the concept to compare the probability distributions	BT4

Prerequisites:

- Concept of basics of probability, permutation, combination

Detailed Syllabus:

Modules	Topics / Course Contents	Periods
I	**Basics Of Probability** Probability – Axioms of probability – Conditional probability – Baye's theorem.	12
II	**Discrete Random Variables** Probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions.	12
III	**Joint Distributions** Functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.	12

IV	**Random Process And Stationary Processes** Auto correlation functions, Cross correlation functions, Properties , Power spectral density , Cross spectral density ,Properties.	12
Total		48

Text Books:

1. *Probability, Random Variables and Stochastic Processes*, A. Papoulis and S. Unnikrishnan Pillai, *4th* Edition ,2017 (reprint) , Mc Graw Hill publication

Reference Books

1. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, 4th edition, 2007 (reprint) Springer International
2. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Fourth Edition, 2012, Pearson Education
3. S. Ross, Introduction to Stochastic Models, 5th Edition, 2014, Academic Press.
4. P. Ramesh Babu, " Probability Theory and Random Processes" , 2017 McGraw Hill Education,
5. Tremblay, J.P. and Manohar, R., *Discrete Mathematical Structures with Applications to Computer Science*, 35th Reprint, 2007, Tata McGraw Hill

SYLLABUS (6th SEMESTER)

Subject Name: SEC4 (Mathematical editing tools)		**Subject Code: MAT012S611**
L-T-P-C: 0-0-4-2	**Credit Units: 4**	**Scheme of Evaluation: P**

Objectives: The objectives of **SEC4 (Mathematical editing tools) (MAT012S601)** are to familiarizing students with the usage of mathematical documentation software (LaTeX).

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the basic of programming.	BT1
CO2	**Understand** the different commands used in LaTex.	BT2
CO3	**Apply** Latex to prepare resume, articles, research paper, presentation, etc.	BT3
CO4	**Analyze** the document prepared by LaTex.	BT4

Prerequisites:

- Knowledge of documentation using any software.

Detailed Syllabus:

Modules	Topics/Course content	Periods
I	**Installation of LaTeX and formatting of output document:** Installation of MikTeX/TeXLive, Class and packages, Latex programming and commands, sample packages, Error messages, Fonts, symbols, paragraphs, line spacing, word spacing, titles and subtitles, Document class, page style, parts of the documents, table of contents, Command names and arguments, environments, declarations, comments within text.	12
II	**Mathematical formulae:** Mathematical environments, math mode, AMS Packages, mathematical symbols, Graphic package, multivalued functions, drawing matrices, mathematical equations, Tables with captions, References to figures, equations and tables in text, Bibliography using ".bibtex" and list of "\bibitem{}"	12

III	**Applications**: Writing Resume, Writing question paper, Writing articles/ research papers.	12
IV	**Presentation using Beamer:** Beamer class, beamer styles, Presentations with mathematical equations, Tables, Graphics, bibliography, Applications.	12
Total		48

Text Book:

2. Guide to LATEX, fourth edition, Helmut Kopka, Patrick W.Daly, Addison-Wesley, England, 2004.

Reference Book:

1. Frank Mittelbach and Ulrike Fischer, *The LaTeX Companion*, 3nd edition (TTCT series), Addison-Wesley Professional, 2023.