AS PER NATIONAL EDUCATION POLICY (NEP) - 2020

Curriculum and Credit Framework for

Four Years Undergraduate Degree with Honours (With/Without Research) in Mathematics

WITH EFFECT FROM THE
ACADEMIC YEAR: 2023-24

Rajiv Gandhi University
(A Central University)
RONO HILLS, DOIMUKH,
ARUNACHAL PRADESH-791112

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs): The main objectives of the B.Sc. Mathematics Programme are to:	
PEO1:	Inculcate strong interest in learning mathematics.
PEO2:	Evolve broad and balanced knowledge and understanding of definitions, key concepts, principles and theorems in Mathematics.
PEO3:	Enable students to apply the knowledge and skills acquired by them during the programme in solving different problems in mathematics and pursuing further studies in mathematics and related disciplines.
PEO4:	Equip the students with basic skills and fundamentals of Research.

PROGRAMME OBJECTIVES (POs):		
	Type of Programme Outcome (PO)	**Programme Outcome (PO) Descriptor**
PO1:	**Problem-Solving**	A graduate student should be able to demonstrate the capability to • solve problems of familiar and non-familiar contexts that are best approached with critical thinking and apply the learning to real-life situations.
PO2:	**Analytical Reasoning & Critical Thinking**	A graduate student should be able to demonstrate the capability to • apply analytical thought to a body of knowledge, including the analysis, evaluation and practices, as well as evidence, arguments, claims, beliefs, and the reliability and relevance of evidence, • identify relevant assumptions or implications; and formulate coherent arguments, • Identify logical flaws in the arguments, analyse and synthesise data from various sources, draw valid conclusions and support them with evidence and examples.
PO3:	**Creativity**	A graduate student should be able to demonstrate the capability to • create, perform, or think in different and diverse ways about the same objects or scenarios, • deal with problems and situations that do not have simple solutions, • innovate and perform tasks in a better manner, • view a problem or a situation from multiple perspectives, • think 'out of the box' and generate solutions to complex problems in unfamiliar contexts, adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.
PO4:	**Communication Skills**	The graduates should be able to demonstrate the skills that enable them to: • listen carefully, read texts and research papers analytically, and present complex information clearly and concisely to peers and the public at large, • express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media, • confidently share views and express herself/himself, • construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice, convey ideas, thoughts, and arguments using respectful and sensitive language to gender and other minority groups.
PO5:	**Research-related Skills**	A graduate student should be able to demonstrate the capability to • a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions, • the ability to problematise, synthesize and articulate issues and design research proposals, • the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships, • the capacity to develop appropriate methodology and tools of data collection, • the appropriate use of statistical and other analytical tools and techniques, • the ability to plan, execute and report the results of an experiment or investigation, the ability to understand basic research ethics and skills in practising/doing ethics in the

		field/ in personal research work, regardless of the funding authority or field of study.
PO6:	**Coordinating / Collaborating with others**	The graduates should be able to demonstrate the ability to: • work effectively and respectfully with diverse teams, • facilitate cooperative or coordinated effort on the part of a group, • act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
PO7:	**Leadership Development**	A graduate student should be able to demonstrate the capability to • mapping out the tasks of a team or an organization and setting direction. • formulating an inspiring vision and building a team that can help achieve the vision, motivating and inspiring team members to engage with that vision. • using management skills to guide people to the right destination.
PO8:	**Digital and technological skills**	A graduate student should be able to demonstrate the capability to • use ICT in a variety of learning and work situations, • access, evaluate, and use a variety of relevant information sources, • use appropriate software for analysis of data.
PO9:	**Multicultural competence and inclusive spirit**	A graduate student should be able to demonstrate the capability to • the acquisition of knowledge of the values and beliefs of multiple cultures and a global perspective to honour diversity, • capability to effectively engage in a multicultural group/society and interact respectfully with diverse groups, • capability to lead a diverse team to accomplish common group tasks and goals. gender sensitivity and adopt gender-neutral approach, as also empathy to the less advantaged and the differently-abled including those with learning disabilities.
PO10:	**Value inculcation**	The graduates should be able to demonstrate the acquisition of knowledge and attitude that are required to: • embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values, • formulate a position/argument about an ethical issue from multiple perspectives • practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies, • identify ethical issues related to work and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights, • adopt objective, unbiased, and truthful actions in all aspects of work, in stil integrity, identify ethical issues related to work, and follow ethical practices.
PO11:	**Environmental awareness and action**	The graduates should be able to demonstrate the acquisition of and ability to apply the knowledge, skills, attitudes, and values required to take appropriate actions for: • recognize environmental and sustainability issues, and participate in actions to promote sustainable development. • mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources and biodiversity,
PO12:	**Community engagement and service**	The graduates should be able to demonstrate the capability to • participate in community-engaged services/ activities for promoting the well-being of society.

PROGRAMME SPECIFIC OBJECTIVES (PSOs): After completing the programme, the students will be:	
PSO1:	Understand basic concepts of pure and applied mathematics
PSO2:	Apply Mathematics as a tool to solve problems of other disciplines
PSO3:	Pursue higher studies in the subject to take part in the academic upliftment of the subject.
PSO4:	Develop new techniques/methods for solving the unsolved problems in mathematics and related disciplines.
PSO5:	Take up Research and Project and present their results efficiently in seminars and conferences.

KEY FACTORS:

1. Students in Mathematics (Honours) would be required to select compulsory Value-Added Courses from the range of value-based courses offered in the common curriculum structure.

2. Students in Mathematics (Honours) would need to choose Minor Courses from those offered by the Chemistry, Physics, and Statistics Departments.

3. Students in Mathematics (Honours) would need to choose Multidisciplinary Courses available in the common structure. This course should not have been studied at the 10+2 level nor selected as a major or minor course in the current program by the student.

4. Students in Mathematics would need to select a Skill Enhancement Course (SEC) in each semester from any discipline, including Mathematics.

5. Students in Mathematics (Honours) would need to choose one Ability Enhancement Courses in each semester from the courses offered by other Departments.

6. Students who secure 75% marks and above in the first six semesters are eligible to undertake undergraduate level research in the fourth year, as per NEP-2020.

7. Students in Mathematics who are not undertaking a research project or dissertation will need to complete three elective courses totaling 12 credits in place of research project/dissertation.

8. Multiple Entry and Exit points will be permitted in the Undergraduate Programmes in accordance with the University guidelines.

Details of Courses of Four Years UG Degree with Honours (Mathematics)

NCrF Credit Level	Semester	Course Code	Course Name	Credits			
				L	T	P	Total
4.5	I	MAT-001- CC -1110	Calculus	3	1	-	4
		XXX-001-AE-1110	AEC-1				4
		MAT-001-SE-0010	Fundamentals of Computers	3	-	-	3
		XXX-001-MC-1110	Minor 1	-	-	-	4
		XXX-001-VA-0010	VAC-1	--	--	--	2
		XXX-001-MD-1110	MDC-1				3
	II	MAT-001- CC -1210	Higher Algebra	3	1		4
		XXX-001-AE-1210	AEC-2				4
		MAT -001-SE-0020	Programming in C	-	-	3 **(End Semester: 80; Internal: 20)**	3
		XXX-001-MC-1210	Minor 2	-	-	-	4
		XXX-001-VA-0020	VAC-2	--	--	--	2
		XXX -001-MD-1120	MDC-2	2	1	--	3
Students exiting the programme after securing 40 credits will be awarded UG Certificate in Mathematics provided they secure additional 4 credits in work-based vocational courses offered during the summer term or internship/ apprenticeship in addition to 6 credits from skill-based courses earned during the first and second semester. Total credits required for UG Certificate in Mathematics: 44							
5.0	III	MAT-001- CC -2310	Elementary Differential Equations	3	1	-	4
		MAT-001- CC -2320	Elementary Linear Algebra	3	1	-	4
		MAT-001-SE-0030	Introduction to MATHEMATICA	-	--	3 **(End Semester: 80; Internal:20)**	3
		XXX-001-MC-2310	Minor 3	3	1	-	4
		XXX-001-VA-0030	VAC-3				2
		XXX-001-MD-2310	MDC-3				3
	IV	MAT-001- CC -2410	Analytic Geometry	3	1		4
		MAT-001- CC -2420	Elementary Complex Analysis	3	1		4
		MAT-001- CC -2430	Real Analysis	3	1	-	4
		MAT-001- CC -2440	Statics	3	1	-	4
		XXX-001-MC-2410	Minor-4	3	1	-	4
Students exiting the programme after securing 80 credits will be awarded UG Diploma in Mathematics provided they secure additional 4 credits in skill-based vocational courses offered during the first year or second year summer term. Total credits required for UG Diploma in Mathematics: 84							
5.5	V	MAT-001- CC -3510	Elementary Abstract Algebra	3	1	-	4
		MAT-001- CC -3520	Elementary Number Theory	3	1	-	4
		MAT-001- CC -3530	Particle Dynamics	3	1	-	4
		XXX-001-MC-3510	Minor-5	3	1	-	4
		MAT-001-IN-3010	Internship	--	--	--	2
		MAT-001-CC-3540	LaTeX	--	--	2 **(End Semester: 80; Internal: 20)**	2
	VI	MAT-001- CC -3610	Metric Space	3	1	-	4
		MAT-001- CC -3620	Advanced Calculus	3	1	-	4
		MAT-001- CC -3630	Linear Programming	3	1	-	4
		MAT-001- CC -3640	Integral Transform and Vector Analysis	3	1	-	4
		XXX-001-MC-3610	Minor-6	3	1	-	4
Students may exit this programme and will be awarded UG Degree in Mathematics upon securing 120 credits upto six semesters.							
6.0	VII	MAT-001- CC -4710	Number Theory	3	1	-	4
		MAT-001- CC -4720	Advanced Real Analysis	3	1	-	4
		MAT-001- CC -4730	Abstract Algebra	3	1	-	4
		MAT-001- CC -4740	Mechanics	3	1	-	4
		MAT-001-RC-4710 (Minor-7)	Research Methodology	3	1	-	4
	*Students who secure 7.5 CGPA (75%) up to seventh semesters are eligible to opt for Research Project (MAT-RP-0010) of 12 credits instead of three core course (CC) elective papers (MAT-CC-48XX/48XX/48XX (Electives – I, II & III))						
	VIII	MAT-001-DE-48xx	Elective-I	-	-	-	4
		MAT-001- DE -48xx	Elective-II	-	-	-	4
		MAT-001- DE -48xx	Elective-III	-	-	-	4
		MAT-001- DE -48xx	Elective-IV	-	-	-	4
		MAT-001-RC-4810 (Minor -8)	Research and Publication Ethics	3		1 **(End Semester: 80; Internal: 20)**	4
Total Credits							**160**

Abbreviations: VAC-Value added course, AEC-Ability enhancement course,
MDC-Multidisciplinary course, SEC-Skill enhancement course.

NOTE: The title of the Ability Enhancement Courses (AEC), Multidisciplinary course (MDC) and Value Added courses (VAC) will be adopted from the pool of papers provided by the University.

Details of Courses of Four Years UG Degree with Honours and Research (Mathematics)

NCrF Credit Level	Semester	Course Code	Course Name	Credits			
				L	T	P	Total
4.5	I	MAT-001- CC -1110	Calculus	3	1	-	4
		XXX-001-AE-XXX	AEC-1				4
		MAT-001-SE-0010	Fundamentals of Computers	3	-	-	3
		XXX-001-MC-1110	Minor 1	-	-	-	4
		XXX-001-VA-0010	VAC-1	--	--	--	2
		XXX-001-MD-1110	MDC-1				3
	II	MAT-001- CC -1210	Higher Algebra	3	1	-	4
		XXX-001-AE-XXX	AEC-2				4
		MAT-001 -SE-0020	Programming in C	-	-	3 **(End-Semester: 80; Internal: 20)**	3
		XXX-001-MC-1210	Minor 2	-	-	-	4
		XXX-001-VA-0020	VAC-2	--	--	--	2
		XXX-001 -MD-1120	MDC-2	2	1	--	3
Students exiting the programme after securing 40 credits will be awarded UG Certificate in Mathematics provided they secure additional 4 credits in work-based vocational courses offered during the summer term or internship/ apprenticeship in addition to 6 credits from skill-based courses earned during the first and second semester. Total credits required for UG Certificate in Mathematics: 44							
5.0	III	MAT-001- CC -2310	Elementary Differential Equations	3	1	-	4
		MAT-001- CC -2320	Elementary Linear Algebra	3	1	-	4
		MAT-001-SE-0030	Introduction to MATHEMATICA	-	--	3 **(End-Semester: 80; Internal: 20)**	3
		XXX-001-MC-2310	Minor 3	3	1	-	4
		XXX-001-VA-0030	VAC-3				2
		XXX-001-MD-2310	MDC-3				3
	IV	MAT-001- CC -2410	Analytic Geometry	3	1	-	4
		MAT-001- CC -2420	Elementary Complex Analysis	3	1	-	4
		MAT-001- CC -2430	Real Analysis	3	1	-	4
		MAT-001- CC -2440	Statics	3	1	-	4
		XXX-001-MC-2410	Minor-4	3	1	-	4
Students exiting the programme after securing 80 credits will be awarded UG Diploma in Mathematics provided they secure additional 4 credits in skill-based vocational courses offered during the first year or second year summer term. Total credits required for UG Diploma in Mathematics: 84							
5.5	V	MAT-001- CC -3510	Elementary Abstract Algebra	3	1	-	4
		MAT-001- CC -3520	Elementary Number Theory	3	1	-	4
		MAT-001- CC -3530	Particle Dynamics	3	1	-	4
		XXX-001-MC-3510	Minor-5	3	1	-	4
		MAT-001-IN-0010	Internship	--	--	--	2
		MAT-001-CC-3540	LaTeX	-	--	2 **(End-Semester: 80; Internal: 20)**	2
	VI	MAT-001- CC -3610	Metric Space	3	1	-	4
		MAT-001- CC -3620	Advanced Calculus	3	1	-	4
		MAT-001- CC -3630	Linear Programming	3	1	-	4
		MAT-001- CC -3640	Integral Transform and Vector Analysis	3	1	-	4
		XXX-001-MC-3610	Minor-6	3	1	-	4
Students may exit this programme and will be awarded UG Degree in Mathematics upon securing 120 credits up to six semesters							
6.0	VII	MAT-001- CC -4710	Number Theory	3	1	-	4
		MAT-001- CC -4720	Advanced Real Analysis	3	1	-	4
		MAT-001- CC -4730	Abstract Algebra	3	1	-	4
		MAT-001- CC -4740	Mechanics	3	1	-	4
		MAT-001-MC-4710 **(Minor -7)**	Research Methodology	3	1	-	4
	VIII	MAT-001-DE-48xx	Elective Paper	3	1	-	4
		MAT-001-RC-4810 **(Minor -8)**	Research and Publication Ethics	3	-	1 **(End-Semester: 80; Internal: 20)**	4
		MAT-001-RP-0010	Research Project	-	-	**(End Semester240: Internal: 60)**	12
Total Credits							**160**

Abbreviations: VAC-Value added course, AEC-Ability enhancement course,
MDC-Multidisciplinary course, SEC-Skill enhancement course.

NOTE: The title of the Ability Enhancement Courses (AEC), Multidisciplinary course (MDC) and Value Added courses (VAC) will be adopted from the pool of papers provided by the University.

ELECTIVE COURSES FOR VIII SEMESTER

Semester	Course Code	Course Name	Credits			
			L	T	P	Total
VIII	MAT-001-DE-4810	Numerical Methods	3	-	1 (End-Semester: 80; Internal: 20)	4
	MAT-001-DE-4820	Linear Algebra	3	1	-	4
	MAT-001-DE -4830	Tensor Calculus	3	1	-	4
	MAT-001-DE-4840	Differential Geometry	3	1	-	4
	MAT-001-DE -4850	Hydrodynamics	3	1	-	4
	MAT-001-DE -4860	Complex Analysis	3	1	-	4
	MAT-001-DE -4870	Differential Equations	3	1	-	4
	MAT-001-DE -4880	Hydrostatics	3	1	-	4
	MAT-001-DE -4890	Probability and Statistics	3	1	-	4

MINOR COURSES (MC)

Semester	Course Code	Course Name	Credits			
			L	T	P	Total
I	MAT-001-MC-1110	Differential and Integral Calculus	3	1	-	4
II	MAT-001-MC-1210	Ordinary Differential Equation	3	1	-	4
III	MAT-001-MC-2310	Modern Algebra	3	1	-	4
IV	MAT-001-MC-2410	Finite Differences and Numerical Methods	3	1		4
V	MAT-001-MC-3510	Statistics and Probability	3	1	-	4
VI	MAT-001-MC-3610	Discrete Mathematics	3	1	-	4
VII	MAT-001-RC-4710	Research Methodology	3	1	-	4
VIII	MAT-001-RC-4810	Research and Publication Ethics	3	-	1 (End-Semester: 80; Internal: 20)	4

SKILL ENHANCEMENT COURSES (SEC)

Semester	Course Code	Course Name	Credits			
			L	T	P	Total
I	MAT-001-SE-0010	Fundamentals of Computers	3	-	-	3
II	MAT-001-SE-0020	Programming in C	-	-	3 (End-Semester: 80; Internal: 20)	3
III	MAT-001-SE-0030	Introduction to MATHEMATICA	-	-	3 (End-Semester: 80; Internal: 20)	3

MULTIDISCIPLINARY COURSES (MDC)

Semester	Course Code	Course Name	Credits			
			L	T	P	Total
I	MAT-001-MD-0010	Elementary Mathematics-I	2	1	-	3
II	MAT-001-MD-0020	Elementary Mathematics-II	2	1	-	3
III	MAT-001-MD-0030	Basic Statistics and Probability	2	1	-	3

ABILITY ENHANCEMENT COURSES (AEC)

Semesters	Course Code	Course Name	Credits			
			L	T	P	Total
I	XXX-001-AE-1110	AEC-1	4	-	-	4
II	XXX-001-AE-1210	AEC-2	4	-	-	4

VALUE ADDED COURSES (VAC)

Semesters	Course Code	Course Name	Credits			
			L	T	P	Total
I	XXX-001-VA-0010	VAC-1	2	-	-	2
II	XXX-001-VA-0020	VAC-2	2	-	-	2
III	XXX-001-VA-0030	VAC-3	2	-	-	2

CORE COURSES

MAT-001-CC-1110
CALCULUS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to acquaint with:
CO1: concepts of limit, continuity and differentiability of different functions.
CO2: the geometrical properties of different functions and their applications.
CO3: some fundamental results in calculus related to differentiation and series expansions.
CO4: higher realms of integral calculus and their applications.

Unit-I: Functions, limit and continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Recursion formulae for higher order derivatives **(Contact Hours: 15)**

Unit-II: Tangent and normal, Curvatures, Asymptotes, Tracing of curves, Derivative in determining increasing, decreasing, and concavity of functions, relative and absolute extrema, and their applications, rectilinear motion and derivative, Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar form.
(Contact Hours: 20)

Unit-III: Rolle's theorem, Mean Value theorems, Taylor's theorem and remainders, Taylor's series, Maclaurin's series and their applications. **(Contact Hours: 10)**

Unit-IV: Integration by successive reduction and applications, area under plane curves, area between two curves, rectification of plane curves (Cartesian, parametric and polar curves), application of integration in determining volumes, areas of surface of revolution.
(Contact Hours: 15)

Books Recommended:

1. T. G. B. Thomas and R. L. Finney, *Calculus*, 13th ed. Pearson Education, Delhi (2017).
2. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand & Co Ltd. (2005).
3. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand & Co Ltd. (2005).
4. B. C. Das and B. N. Mukherjee, *Differential Calculus*. U.N. Dhur & Sons Pvt. Ltd. (2009).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	3	3	1	1	0
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	3	1	1	0
CO3	3	3	1	1	-	-	-	-	-	-	-	-	3	2	1	1	0
CO4	3	3	1	1	-	-	-	-	-	-	-	-	3	3	1	1	0
Average	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.8**	**1**	**1**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC -1210
HIGHER ALGEBRA
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Understand and employ De Moivre's theorem in various trigonometric functions and their expansions.
CO2: Solve different polynomial equations and understand relations between their roots.
CO3: Recognize consistent and inconsistent systems of linear equations using matrix method.
CO4: Solve problems using software.

Unit-I: Polar representation of complex numbers, n^{th} roots of Unity, De Moivre's theorem for rational indices and its applications, Expansions of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$, Evaluation of indeterminate quantities, Expansions of $\sin^n \theta$ and $\cos^n \theta$ in cosines or sines of multiples of θ, Expansions of $\sin n\theta$ and $\cos n\theta$ in series of descending and ascending powers of $\sin \theta$ and $\cos \theta$. **(Contact Hours: 15)**

Unit-II: Euler's expansion of cosine and sine, Hyperbolic functions and its applications; Inverse functions; Logarithmic functions of complex numbers; Gregory's series and its applications.
(Contact Hours: 15)

Unit-III: Polynomials and division algorithm; Roots of polynomial equations, Relations between the roots and the coefficients, Transformation of equations; Descartes rule of signs; Solution of cubic and biquadratic equations. **(Contact Hours: 10)**

Unit-IV: Determinants & Matrices; Minors and cofactors, adjoint and inverse of a matrix. Systems of linear equations, row reduction and normal forms, echelon forms, elementary operations on matrices, consistency of systems of linear system equations Ax=b, Gauss elimination method. symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal matrices. Elementary operations on matrices. Rank of a matrix.
(Contact Hours: 20)

Books Recommended:

1. J. Hall and P. Knight, *Higher Algebra* Arihant Publications (2016).
2. S. Barnard and J M. Child, *Higher Algebra*, New Age International Private Limited (2024).
3. B.C. Das and M. Mukherjee, *Higher Trigonometry*, U.N. Dhur & Sons (P) Ltd. (2012).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	3	3	0	0	0
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	1	0	1	0
CO3	3	3	1	1	-	-	-	-	-	-	-	-	3	3	1	1	0
CO4	3	3	1	1	-	-	-	-	-	-	-	-	0	2	1	1	0
Average	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.3**	**2.3**	**0.5**	**0.8**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC -2310
ELEMENTARY DIFFERENTIAL EQUATIONS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable the students to:
CO1: Learn basics of differential equations.
CO2: Learn different methods for solving differential equations.
CO3: Learn the concept of partial differential equations.

Unit-I: Order and degree of ordinary differential equation, formation of differential equation, General solution, variable separable form, Homogeneous differential equations, Equation reducible to Homogeneous from. **(Contact Hours: 10)**

Unit-II: Exact ordinary differential equations, equation reducible to exact form, Integrating factors, rules to find an integrating factor. Linear equation (including Bernoulli's equation and other simple cases reducible to linear), First order higher degree equations solvable for x, y, p. Methods for solving higher-order ordinary differential equations. **(Contact Hours: 20)**

Unit-III: Linear ordinary differential equations second order with constant coefficients. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, the method of variation of parameters, Simultaneous differential equations, Total differential equations. **(Contact Hours: 20)**

Unit-IV: Introduction to partial differential equations, concept of linear and non-linear partial differential equations, formation of partial differential equations. **(Contact Hours: 10)**

Books Recommended:

1. S. L. Ross, *Differential Equations*, 3rd Ed., Wiley; 3rd edition , (2007).
2. R. Bronson and V. Gejji, *Differential Equations*, McGraw Hill Education; 3rd edition (2017).
3. M. D. Raisinghannia, *Ordinary and Partial Differential Equation.* S. Chand and Co. (2020).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO2	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO3	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
Average	**3**	**3**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**1**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-2320
ELEMENTARY LINEAR ALGEBRA
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Learn about the concept of linear independence and dependence of vectors over a field, basis and the dimension of a vector space.
CO2: Basic concepts of linear transformations and matrix representation of a linear transformation
CO3: Compute characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces.
CO4: Learn about the concept of linear functional and dual space.

Unit-I: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, linear sums and direct sums. **(Contact Hours: 15)**

Unit-II: Linear transformations, null space, range, rank and nullity of a linear transformation, dimension theorem, singular and non-singular linear transformations and isomorphism, algebra of linear transformations, matrix representation of a linear transformation and change of basis matrix. **(Contact Hours: 20)**

Unit-III: Characteristic polynomial of matrices, eigenvalues and eigen vectors, diagonalization. Cayley-Hamilton theorem and its use in finding the inverse of a matrix. **(Contact Hours: 15)**

Unit-IV: Linear functional, Dual Space, Dual Basis, Double dual, Annihilators and Transpose of a linear mapping. **(Contact Hours: 10)**

Books Recommended:

1. K. Hoffman and R. A Kunze, *Linear Algebra*, 2nd Ed., Prentice-Hall of India Pvt. Ltd., (2015).
2. S. Lipschutz, *Beginning Linear Algebra*, McGraw Hill (2020).
3. *Gilbert* Strang, *Linear Algebra And Its Application*, Cengage Learning India (2005).
4. S. K. Mapa, *Higher Algebra: Abstract and Linear*, Levant Books India (2020).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	1	-	-	-	-	-	-	3	1	1	1	0
CO2	3	3	1	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO3	3	3	1	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO4	3	3	1	1	-	1	-	-	-	-	-	-	3	1	1	0	0
Average	**3**	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1.5**	**1**	**0.8**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001- CC -2410
ANALYTIC GEOMETRY
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Learn the basic tools of two dimensional coordinate system.
CO2: Learn Cartesian and Polar forms of conic sections and their properties.
CO3: Have a rigorous understanding of the concept of three dimensional coordinate systems and three dimensional shapes.

Unit-I: Change of Axes: Transformation of coordinates, Translation of axes, Rotation of axes, Removal of xy-terms and the first degree terms, Invariants. Pair of Straight lines: Homogeneous equations of second degree, Angle between a pair of lines, Bisectors of the angles between the pair of lines, Condition for the general equation of second degree to represent a pair of lines, pairs of parallel and perpendicular lines, points of intersection of a line and curve. **(Contact Hours: 20)**

Unit-II: Conic section; Parabola, hyperbola, and ellipse. general conics: tangent, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standard forms, central conics, equation of the axes, and length of the axes, polar equation of a conic, tangent and normal and properties. **(Contact Hours: 15)**

Unit-III: Introduction to three dimensional geometry: Different forms of straight lines and planes, Skew lines, Coplanar lines, Angle between two planes, Shortest distance between two lines and equations of shortest distance. Sphere: Plane section of a sphere, intersection of two spheres, sphere with a given diameter, Equation of a sphere through a given circle.
(Contact Hours: 15)

Unit-IV: Cones and Cylinders: Definition, Equation of a cone with a conic as guiding curve, the right circular cone, its definition and equation. Definition and equation of cylinder and right circular cylinder. **(Contact Hours: 10)**

Books Recommended:
1. R. M. Khan, *Analytical Geometry of Two and Three dimension and vector analysis*. New Central Book Agency (2012).
2. P. R. Vittal, *Analytic Geometry: 2D and 3D*, Pearson Education India (2013).
3. R. J. T. Bell, *Coordinate Solid Geometry*, Macmillan, (1983).
4. S. B. Sengupta, *Coordinate geometry and vector analysis*, Joydurga Library Pvt. Ltd. (2021).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2	1	0	0
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2	0	0	0
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	2	1	0	0
Average	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**0.7**	**0**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-2420
ELEMENTARY COMPLEX ANALYSIS
Credit: 4 (L-3, T-1, P-1)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Learn about limit and continuity properties of complex functions.
CO2: Learn about differentiability of complex functions and Cauchy-Riemann equations.
CO3: Learn about line and contour integrals and underlying theorems.
CO4: Understand the power series and their properties.

Unit-I: Properties of complex numbers, regions in the complex plane. Functions of complex variable. limits, limits involving the point at infinity and L' Hospital's rule. Continuity and uniform continuity of complex functions. **(Contact Hours: 10)**

Unit-II: Derivatives, differentiation formulae, analytic functions, Cauchy-Riemann equations, necessary and sufficient conditions for differentiability. Harmonic functions and harmonic conjugate. Exponential functions, logarithmic functions and trigonometric functions.
(Contact Hours: 10)

Unit-III: Curves, contour and Jordan curve, complex line integration, evaluations of contour integrals of simple functions using direct definition, connection between real and complex line integrals, upper bounds for moduli of contour integrals and ML-inequality, change of variable and evaluation of line integrals, simply and multiply connected regions, Cauchy's theorem and Cauchy-Goursat theorem, Morera's theorem, some consequences of Cauchy's theorem, extension of Cauchy's theorem to multiply-connected region. **(Contact Hours:25)**

Unit-IV: Power series, Absolute convergence, Uniform convergence of power series, Weierstrass M-test, radius and domain of convergence, Taylor series, Maclaurin's series. **(Contact Hours: 15)**

Books Recommended:

1. J. W. Brown and R. V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw Hill Education (2017).

2. M. R Spiegel, *Theory and Problems of Complex Variables,* Schaum's Ouline Series, McGraw Hill (1981).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	3	2	2	1	0
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	2	1	1	0
CO3	3	3	1	1	-	-	-	-	-	-	-	-	3	2	1	1	0
CO4	3	3	1	1	-	-	-	-	-	-	-	-	3	2	1	1	0
Average	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1.3**	**1**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001- CC-2430
REAL ANALYSIS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Learning Outcomes: This course will enable the students to:
CO1: Understand the basic properties of real numbers, real sequences and series.
CO2: Apply the comparison (limit form), ratio, root, and Leibnitz tests for convergence and absolute convergence of an infinite series of real numbers.
CO3: Understand the theory of Riemann integration.

Unit-I: Algebra of real numbers, order, upper and lower bounds, least upper bound (LUB)and greatest lower bound (GLB), order-completeness, cardinality, countability, intervals, neighbourhood, closure, limit and interior points, open sets, closed sets, closure, interior and boundary of sets, dense set, compactness, Bolzano-Weierstrass theorem, Cantor's theorem, Heine-Borel theorem. **(Contact Hours: 15)**

Unit-II: Sequences, Cauchy sequences, convergence and divergence of sequences, Cauchy's general principle of convergence, subsequences, Bolzano-Weierstrass theorem for sequences, monotonic sequence, Weierstrass completeness principle, limit superior and limit inferior.
(Contact Hours: 15)

Unit-III: Infinite series, convergent series, series of positive terms, tests for convergence of series : comparison test, D'Alembert's ratio test, Cauchy's root test, Raabe's test, Leibnitz's test, absolute convergence, rearrangement of terms of a series, conditionally convergent series.
(Contact Hours: 15)

Unit-IV: Riemann integration: definitions, geometrical interpretation and examples, Darboux's theorem, existence of Riemann integral and conditions for integrability, integral as a limit of a sum, mean value theorem, fundamental theorem of calculus. **(Contact Hours: 15)**

Books Recommended:

1. S. K. Mapa, *Introduction to Real Analysis*, Levant Books India; 9th Edition (2022).
2. S. C. Mallik and S. Arora, *Mathematical Analysis*, New Age Int. Pub. (2017).
3. H. L. Royden and P. M. Fitzpatrick, *Real Analysis*, Pearson Education India; 4th edition (2015).
4. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis* Wiley (Asia) Pvt. Ltd., (2011).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	3	1	3	0	0
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	1	0	0	0
CO3	3	3	1	1	-	-	-	-	-	-	-	-	3	1	1	0	0
CO4	3	3	1	1	-	-	-	-	-	-	-	-	**3**	**1**	**1.2**	**0**	**0**
Average	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	1	3	0	0

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC -2440

STATICS

Credit: 4 (L-3, T-1, P-0)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:

CO1: Comprehend the fundamentals of system of coplanar forces and static equilibrium

CO2: Determine centre of gravity of different areas bounded by curves and solids, and their applications.

CO3: Understand the basic principles and laws of friction.

Unit – I: Coplanar forces: Resultant and Components, Parallelogram of forces, triangle law of forces, converse of triangle law of forces, Lami's Theorem and its converse, Like and unlike parallel forces, moment of a force about a point and an axis. Couple, resultant of a system of forces. Equilibrium of coplanar forces, system of coplanar forces reducible to a single force and a couple. **(Contact Hours: 30)**

Unit – II: Centre of Gravity: Definitions, Conditions of equilibrium, centre of gravity of a plane area, arc and a sector of a curve, centre of gravity of solids and surface of revolution, centre of gravity of areas bounded by curves, applications on CG, Catenary. **(Contact Hours: 15)**

Unit – III: Friction: Idea of Friction, laws of friction, angle of friction, coefficient of friction, equilibrium on rough planes and inclined planes. **(Contact Hours: 15)**

Books Recommended:

1. S. L. Loney, *The elements of Statics and Dynamics* (Part-I), Arihant Publications (2016).

2. A. S. Ramsay, *Statics*, Cambridge University Press (2009).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	-	1	-	-	-	-	-	-	3	2	2	1	1
CO2	3	3	1	-	-	1	-	-	-	-	-	-	3	2	2	1	1
CO3	3	3	1	-	-	1	-	-	-	-	-	-	3	2	2	1	1
Average	**3**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**1**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-3510
ELEMENTARY ABSTRACT ALGEBRA
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Recognize fundamental algebraic structures like group, rings, integral domain, field and their properties.
CO2: Analyze different types of algebraic structures in the category of groups, rings, integral domain and fields.
CO3: Solve problems using above mentioned powerful concepts.
CO4: Apply the notions in handling real life problems.

Unit-I: Relations and binary operations, permutations, groups and subgroups, Caley's table, order of groups and elements, finite groups, cosets, Lagrange's theorem and its applications. (**Contact Hours: 15)**

Unit-II: Properties of permutations, even and odd permutations, symmetric group, alternating group, cyclic groups and its properties. **(Contact Hours: 10)**

Unit-III: Normal subgroup, quotient or factor groups; group homomorphism-Definition and examples, properties of homomorphism, fundamental theorem on group homomorphism, isomorphism, Cayley's theorem. **(Contact Hours: 20)**

Unit-IV: Rings-definition and examples, commutative and non-commutative rings, subrings and its characterizations, ideals, and quotient ring, integral domains, division rings and fields.
(Contact Hours: 15)

Books Recommended:

1. I. N. Heirstein, *Topics in Algebra*, Wiley; 2nd Edition (2006).
2. S. Singh and Q. Zameerudin, *Modern Algebra*, Vikas Pub. House. Pvt Ltd. (2006).
3. V. K. Khanna and S. K. Bhambri, *A Course in Abstract Algebra*, Vikas Pub. House. Pvt Ltd. (2017).
4. S. K. Mapa, *Higher Algebra: Abstract and Linear*, Levant Books India; 15th Edition (2020).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	1	-	1	-	-	-	-	-	-	3	2	2	1	0
CO2	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO3	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO4	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
Average	**3**	**3**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1.3**	**1**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-3520
ELEMENTARY NUMBER THEORY
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Learning Outcomes: This course will enable the students to:
CO1: Know about divisibility properties of numbers and fundamental theorem of arithmetic.
CO2: Solve Diophantine equations, linear and system of linear congruence, residue systems and applications.
CO3: Know about various arithmetic functions and their properties.

Unit-I: Well-ordering principle, divisibility, division algorithm, greatest common divisor, least common multiple, primes, fundamental theorem of arithmetic and applications.
(Contact Hours: 15)

Unit-II: Linear Diophantine equation, definition of congruence and properties. linear congruence, Chinese remainder theorem. **(Contact Hours: 15)**

Unit-III: Complete residue system, reduced residue system, Euler's phi function, Euler's theorem, Fermat's little theorem and Wilson's theorem and applications. **(Contact Hours: 15)**

Unit-IV: Arithmetic functions, sum and number of divisors functions, Möbius function, multiplicative functions, Dirichlet product and properties, the Möbius inversion formula, group properties of arithmetic functions, the greatest integer function, completely multiplicative functions.
(Contact Hours: 15)

Books Recommended:

1. D. M. Burton, *Elementary Number Theory*, 6th Ed., Tata McGraw Hill, Indian reprint, (2007).
2. N. Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, (2007).
3. I. Niven, H. S. Zuckerman, and H. L. Montgomery, *An Introduction to theory of numbers*, Wiley (2008).
4. S. B. Malik: Basic Number Theory, S Chand. (2018).

COs- Pos/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	1	-	1	-	-	-	-	-	-	3	1	2	1	1
CO2	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	1	0
CO3	3	3	-	1	-	1	-	-	-	-	-	-	3	2	2	1	1
Average	**3**	**3**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1.7**	**1.7**	**1**	**0.7**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC -3530
PARTICLE DYNAMICS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:
CO1: Understand the fundamental concepts behind the motion of particles in a variety of medium.
CO2: Learn about projectiles, motion in resisting medium and energy involved.
CO3: Understand the concept of motion under central forces, Newton's law of gravitation and Kepler's laws of planetary orbit.

Unit – I: Kinematics: Components of velocity and acceleration in Cartesian coordinates, radial and transverse, tangential and normal forms, angular velocity and acceleration, motion in a straight line, motion under inverse square law and variable accelerations, simple harmonic motion (SHM), elastic strings and Hook's law. **(Contact Hours: 30)**

Unit – II: Motion in Plane: Projectiles on a plane and on an inclined plane with range and time of flights, motion in resisting medium (simple cases only), kinetic and potential energies, work done, conservation of energy with simple examples. **(Contact Hours: 15)**

Unit – III: Central orbits: Motion of a particle under central force, differential equation of central orbit in polar and pedal forms, apse, apsidal distance and apsidal angle on a central orbit, Newton's law of gravitation, planetary orbit and Kepler's law. **(Contact Hours: 15)**

Books Recommended:
1. S. L. Loney, *The elements of Statics and Dynamics* (Part-II), Arihant Publications (2016).
2. A. S. Ramsay, *Dynamics,* Cambridge University Press, (2009).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	0	1
CO2	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	0	1
CO3	3	3	-	1	-	1	-	-	-	-	-	-	3	2	1	0	1
Average	**3**	**3**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**0**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-3540

LATEX

Credit: 2 (L-0, T-0, P-2)

Total Contact Hours: 30

Practical: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:

CO1: Create and typeset a LaTeX document.

CO2: Typeset a mathematical document using LaTex.

CO3: Learn about pictures and graphics in LaTex.

CO4: Create beamer presentations.

Unit-I: Getting Started with LaTeX: Introduction to TeX and LaTeX, typesetting a simple document, adding basic information to a document, environments, footnotes, sectioning and displayed material. **(Contact Hours: 10)**

Unit-II: Mathematical Typesetting with LaTeX: Accents and symbols, mathematical typesetting (elementary and advanced)**:** Subscript/ superscript, fractions, roots, ellipsis, mathematical symbols, arrays, delimiters, multiline formulas, spacing and changing style in math mode.

(Contact Hours: 10)

Unit-III: Graphics and Beamer Presentation in LaTeX: Graphics in LaTeX, simple pictures using PSTricks, plotting of functions, beamer presentation. **(Contact Hours: 10)**

Books Recommended:

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

2. L. Lamport, *LaTeX*: *A Document Preparation System*, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint (1994).

3. M. R. C. van Dongen, *LaTeX and Friends*. Springer-Verlag (2016).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	3	1	-	-	2	-	-	-	-	0	0	0	0	2
CO2	-	-	-	3	1	-	-	2	-	-	-	-	0	0	0	0	2
CO3	-	-	-	3	1	-	-	2	-	-	-	-	0	0	0	0	2
Average	-	-	-	**3**	**1**	-	-	**2**	-	-	-	-	0	0	0	0	2

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC -3610
METRIC SPACE
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Learning Outcomes: The course will enable the students to:
CO1: Recognize the distance functions, continuity, compactness and connectedness in abstract setting.
CO2: Understand the concept of convergence, divergence and existence of limits in a metric space.
CO3: Correlate these concepts to their counter parts in real analysis and abstract topological spaces.
CO4: Analyze the completeness properties in metric spaces using Cauchy sequence criteria.

Unit–I: Distance functions, metric spaces: definition and examples, open and closed sphere, interior point, interior of a set, open set and related theorems, closure point and closure of a set, dense and nowhere dense sets, limit point, derived sets, closed sets and their properties.
(Contact Hours: 10)

Unit–II: Sequences and their convergence: definition and examples, basic properties: uniqueness of limit, equivalence of $x_n \to x$ with $d(x_n, x) \to 0$ in $\mathbb{R}^n$, continuous functions ($\epsilon - \delta$ definition in and sequential definition), relation with closed sets and open sets, uniform continuity, test of function for uniform continuity. **(Contact Hours: 20)**

Unit–III: Cauchy sequence, complete metric space and examples, Cantor's intersection Theorem, Baire's category theorem. **(Contact Hours: 10)**

Unit–IV: Connectedness, connected subsets of $\mathbb{R}^n$, connectedness and continuous mappings, compactness, Bolzano-Weierstrass theorem, sequentially compact and compactness of metric spaces, Heine-Borel theorem. **(Contact Hours: 20)**

Books Recommended:

1. G. F. Simmon, *Introduction to Topology and Modern Analysis*, Tata McGraw Hill (2004).

2. S. Shirali and H. L. Vasudeva, *Metric Spaces, Springer (2000).*

3. J. Sengupta, Metric Spaces, U. N. Dhur & Sons Pvt. Ltd.; 4th edition (2005).

4. P. K. Jain and K. Ahmad: Metric Spaces, Narosa (2004).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	1	-	-	-	-	-	-	-	0	0	0	0	2
CO2	3	3	1	1	1	-	-	-	-	-	-	-	0	0	0	0	2
CO3	3	3	1	1	1	-	-	-	-	-	-	-	0	0	0	0	2
Average	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	0	0	0	0	2

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-3620

ADVANCED CALCULUS

Credit: 4 (L-3, T-1, P-0)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:

CO1: Understand the concepts of improper integrals.

CO2: Understand the notion of functions of several variables, partial derivatives and applications.

CO3: Evaluate double and triple integrals, and their applications.

Unit I: Functions of two or more variables, implicit and explicit functions, limits and continuity of functions of two variables, partial derivatives, homogenous functions, Euler's theorem on homogenous function, total derivatives, and differentiation of implicit function.

(Contact Hours: 15)

Unit II: Change of variables, Jacobian and its properties, Taylor's theorem, extreme values: maxima and minima, Lagrange's method of undetermined multipliers, differentiation under the integral sign.

(Contact Hours: 15)

Unit III: Improper integrals, types of improper integrals and their convergence, Comparison tests for convergence, Cauchy's test for convergence, absolute convergence, Gamma function, Beta function. **(Contact Hours: 15)**

Unit IV: Double and triple integrals, change of order of integration, change of variables in multiple integral, application of multiple integral, area enclosed by plane curves, area of curved surface, and volume of solids. **(Contact Hours: 15)**

Books Recommended:

1. S. C. Malik and S. Arora, *Mathematical Analysis*, New Age International Publishers, (2017).

2. R. Werede and M. Spiegel, *Advanced Calculus*, McGraw Hill Education; 3rd edition (2010).

3. A. Friedman, Advanced Calculus, Dover Publication (2007).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	1	2	-	-	-	-	-	-	3	3	0	0	0
CO2	3	3	1	-	1	2	-	-	-	-	-	-	3	3	1	0	2
CO3	3	3	1	-	1	2	-	-	-	-	-	-	3	3	2	1	1
Average	**3**	**3**	**1**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**	**0.3**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC -3630
LINEAR PROGRAMMING
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable the students to:
CO1: Understand about the optimization problems and its applications towards different fields.
CO2: Determine optimal solutions of various types of optimization problems.
CO3: Correlate the concept of linear programming to their counter parts in real world problems.

Unit–I: Hyperplanes and hyperspheres, convex sets and their properties: convex combination, convex hull, convex polyhedron and simplex, extreme point, supporting and separating hyperplanes, convex function, formulation of linear programming problem (LPP), optimal solutions and graphical interpretation of optimality, solving LPP using graphical methods.
(Contact Hours: 15)

Unit–II: Slack and surplus variables, canonical and standard forms of LPPs, basic solution, basic feasible solutions (BFS), algebraic interpretation of extreme point, reduction of a feasible solution to a basic feasible solution, relationship between extreme points and corresponding BFS, adjacent extreme points and corresponding BFS along with examples, fundamental theorem of LPP and its illustration through examples, condition of optimality. **(Contact Hours: 15)**

Unit–III: Initial BFS, simplex methods, unbounded and alternative solution, illustration through examples. **(Contact Hours: 10)**

Unit–IV: Artificial variables and its interpretation in context of feasibility, two-phase and Big-M methods and illustration, degeneracy and its consequences including cases of cycling.
(Contact Hours: 20)

Books Recommended:

1. M. H. K. Swarup, P. K. Gupta and Mon Mohan: *Operation Research*, Sultan Chand & Sons. (2017).
2. S. K. Sharma, *Linear programming*, Cyber Tech Publications (2009).
3. F. S. Hillier and G. J. Lieberman, *Introduction to Operation Research SIE*, McGraw Hill Education; Tenth edition (2017).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	-	1	2	-	-	-	-	-	-	3	3	1	1	2
CO2	3	3	2	-	1	2	-	-	-	-	-	-	3	3	0	1	2
CO3	3	3	2	-	1	2	-	-	-	-	-	-	0	3	2	1	2
Average	**3**	**3**	**2**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**1**	**2**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-3640

INTEGRAL TRANSFORM AND VECTOR CALCULUS

Credit: 4 (L-3, T-1, P-0)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:

CO1: Understand Laplace and Fourier transforms and their properties.

CO2: Solve different types of ordinary differential equations using integral transforms.

CO3: Learn basic concept of vector differentiation, Gradient, Divergence, Curl, and their applications.

Unit I: Laplace Transform: Laplace transforms of some elementary functions, linearity property, first and second translational or shifting theorem, change of scale property, Laplace transforms of derivatives multiplication by powers of t, and related problems **(Contact Hours: 15)**

Unit II: The inverse Laplace transform: Definition, some inverse Laplace transforms properties of inverse Laplace transform, inverse Laplace transforms of derivatives, multiplication by s, convolution property, partial fraction method, complex inversion formula, application to differential equations. **(Contact Hours: 15)**

Unit III: Fourier Transform: Fourier integral, sine and cosine transform, inverse Fourier transform, application of Fourier transform to ordinary differential equations. **(Contact Hours: 15)**

Unit-IV: Vector Calculus: Scalar triple product, vector triple product, ordinary and partial differentiation of a vector function, derivative of sum, dot product and cross product of two vectors, gradient, divergence, curl and their applications. **(Contact Hours: 15)**

Books Recommended:

1. M. R. Spiegel, *Theory and problems of Laplace Transform*, Schaum's Series, Tata McGraw-Hill (2005).
2. J. K. Goyal and K. P. Gupta, *Laplace and Fourier Transforms*, Pragati Prakashan (2016).
3. M. Spiegel, *F*ourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series), McGraw Hill Education, (1974).
4. M. Spiegel, S. Lipschutz and D. Spellman, *Vector Analysis*, McGraw Hill Education; 2nd edition (2017).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	1	2	-	-	-	-	-	-	3	3	1	1	2
CO2	3	3	-	-	1	2	-	-	-	-	-	-	3	3	1	1	2
CO3	3	3	-	-	1	2	-	-	-	-	-	-	3	3	1	1	2
Average	**3**	**3**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**	**1**	**2**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-4710
NUMBER THEORY
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory-100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to
CO1: Understand the theory and applications of quadratic congruences.
CO2: Know about the Diophantine equations of second order and Fermat's last theorem, and applications of primitive roots in solving congruences.
CO3: Know representations of number as sum of squares and properties of Fibonacci sequence.
CO4: Understand the basics of Partition theory of numbers and related results.

Unit-I: Quadratic congruence, quadratic residue, Euler's criterion for quadratic residue, Legendre symbol and properties; quadratic reciprocity law, Jacobi symbol and properties, polynomial congruence. **(Contact Hours: 15)**

Unit-II: Diophantine equations of second degree; Fermat's last theorem, primitive roots and indices. **(Contact Hours: 15)**

Unit-III: Representations of integers as Sum of two squares; Difference of two squares; Sum of three squares; Sum of four squares. Fibonacci sequence and their properties, Binet's formula for Fibonacci numbers. **(Contact Hours: 10)**

Unit-IV: Partitions of integer, graphical representation and conjugate partition, partitions into odd parts, partitions into distinct parts, partitions into even parts and their generating functions, Euler's pentagonal number theorem, Jacobi's triple product identity and applications.**(Contact Hours: 20)**

Books Recommended:

1. I. Niven, H. S. Zuckerman and H.L. Montgomery: *An Introduction to the Theory of Numbers* (6^{th} edition), John Wiley and Sons. (2003).
2. D. M. Burton, *Elementary Number Theory* (4 Ed.) Universal Book Stall, New Delhi (2002).
3. T. M. Apostol, *Introduction to Analytic Number Theory*, Springer International Student Edition, Narosa Publishing House, Fourth Reprint, (1993).
4. G. E. Andrews, *Number Theory*, Hindustan Publishing Corporation, New Delhi, (1992).
5. S. B. Malik: Basic Number Theory, S Chand. (2018).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	2		-	-	-	-	-	-	3	1	2	1	1
CO2	3	3	-	-	2		-	-	-	-	-	-	3	1	1	1	1
CO3	3	3	-	-	2		-	-	-	-	-	-	3	2	1	1	1
CO4	3	3	-	-	2		-	-	-	-	-	-	3	2	3	1	3
Average	**3**	**3**	**-**	**-**	**2**		**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1.5**	**1.8**	**1**	**1.5**

High-3, Medium-2, Low-1, No Correlation-0

MAT- 001-CC -4720
ADVANCED REAL ANALYSIS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Understand the concept of sequence and series of functions and their convergence theory.
CO2: Understand the concept and properties of Riemann-Stieltjes (R-S) integral.
CO3: Understand fundamentals of measure theory and Lebesgue integrals.

Unit-I: Uniform convergence: sequence and series of functions, pointwise and uniform convergence, Cauchy's criterion for uniform convergence of a series, uniform convergence and continuity, integration and differentiation. Weirstrass's approximation theorem.
(Contact Hours: 15)

Unit-II: Definition and existence of Riemann-Stieltjes (R-S) integral, properties of R-S integral, integrations and differentiations. **(Contact Hours: 10)**

Unit-III: Lebesgue exterior measure, Lebesgue measure of sets, theorems on measurable sets. Definition of measurable functions, properties of measurable functions and simple functions.
(Contact Hours: 15)

Unit IV: Lebesgue integral of bounded function, definition and theorem involving Lebesgue integral, relationship of Lebesgue and Riemann integral. Fatou's Lemma, monotone convergence theorem, the general Lebesgue integral, Lebesgue convergence theorem. **(Contact Hours: 20)**

Books Recommended:

1. H. L. Royden, *Real Analysis*, PHI (2017).
2. W. Rudin, *Principles of Mathematical Analysis*, Mcgraw Hills Education, 3rd Edition, (2023).
3. P. K. Jain, V. P. Gupta and P. Jain, *Lebesgue measure and integration*, Wiley (2019).
4. T. M. Apostol, *Mathematical Analysis*, Narosa Publishing House, New Delhi (2002).
5. R. Werede and M. Spiegel, *Advanced Calculus*, McGraw Hill Education; 3rd edition (2010).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	2	-	-	-	-	-	-	-	3	1	2	0	1
CO2	3	3	1	-	2	-	-	-	-	-	-	-	3	2	2	0	1
CO3	3	3	1	-	2	-	-	-	-	-	-	-	3	3	2	0	1
Average	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**0**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-4730
ABSTRACT ALGEBRA
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Total Marks: 100 (Theory: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Gain knowledge on class equation, Sylow's theorems and their applications, direct product of groups, Jordan holder theorem, solvable groups, field theory, ideal of a ring, EDs, PIDs, & UFDs and relationships among them.
CO2: Identify and analyze different types of algebraic structures in the category of groups, rings, ideals and fields.
CO3: Emphasize on field structures such as algebraically closed fields, splitting fields and field extensions and to use the fundamental results in algebra.
CO4: Find out the number of subgroups, normal subgroups of a finite group and solve problems using above mentioned powerful concepts.

Unit-I: Conjugacy class, normalizer, centralizer, centre of a group, class equations, Cauchy theorem, Sylow's theorems, applications of Sylow's theorems. **(Contact Hours: 15)**

Unit-II: Direct products of finite numbers of groups, decomposable groups. normal and subnormal series of groups, composition series, Schreier's refinement theorem, Jordan holder theorem, commutators, derived subgroups, solvable groups. **(Contact Hours: 15)**

Unit-III: Ideals, principal and prime ideals. integral domain and quotients of an integral domain, divisibility in commutative rings, PID, UFD and their properties, Eisenstein's irreducibility criterion. **(Contact Hours: 15)**

Unit-IV: Field theory, extension of fields, algebraic and transcendental numbers, splitting field, existence of finite fields and Galois's group. **(Contact Hours: 15)**

Books Recommended:

1. I. N. Herstein, *Topics of Algebra* 2nd edition, Wiley Eastern (1975).
2. M. Artin, *Algebra*, Prentice Hall of India (1994).
3. D. S. Dummit and R.M. Foote, *Abstract Algebra*, John Wiley and Sons Inc. 2nd Edition (1999).
4. Vijay K Khanna and S K Bhambri: A Course in Abstract Algebra, Vikas Publishing; (2017).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	2	1	-	-	-	-	-	-	3	1	3	2	3
CO2	3	3	-	-	2	1	-	-	-	-	-	-	3	1	3	2	3
CO3	3	3	-	-	2	1	-	-	-	-	-	-	3	1	3	2	3
CO4	3	3	-	-	2	1	-	-	-	-	-	-	3	1	3	2	3
Average	**3**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**3**	**2**	**3**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-CC-4740
MECHANICS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Understand the basic concepts Mechanics.
CO2: Apply the principles of mechanics for solving practical problems related to equilibrium of rigid bodies.
CO3: Apply the principles of mechanics for solving practical problems related to particle in motion.
CO4: Apply concepts of Conservation principles, Lagrange's equations and Hamilton's Equation.

Unit-I: Moments and products of inertia: Definitions, parallel axes theorem, theorem of six constants, D' Alembert's principle, momental ellipsoid, equimomental system, principal axes, moment of momentum. **(Contact Hours: 15)**

Unit-II: Conservation of Momentum and Energy: Principle of conservation of linear momentum and angular momentum under finite and impulsive forces, conservation of energy, conservative forces. **(Contact Hours: 15)**

Unit-III: Lagrange's Equations: Generalized coordinates, degrees of freedom, holonomic system, Lagrange's equations of motion for finite forces, conservative forces, small oscillation. **(Contact Hours: 15)**

Unit-IV: Hamilton's Equations of motion: Generalized velocities, Lagrangian and generalized momentum, Hamilton's canonical equations, Hamilton's principle and principle of least action. **(Contact Hours: 15)**

Books Recommended:

1. S. L. Loney, A*n Elementary Treatise on the Dynamics of A Particle & of Rigid Bodies,* G.K. Publications Private Limited (1916).
2. H. Goldstein, *Classical Mechanics*, Pearson Education; 3rd edition (2011).
3. M. R. Spiegel, *Theoretical Mechanics* (Schaum's Outline Series), McGraw Hills Education (2017).
4. F. Chorlton, *Text book of Dynamics*, CBS *Publishers* & Distributors Pvt. Ltd., New Delhi (2004).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	2	-	-	-	-	-	-	3	3	1	1	1
CO2	3	3	-	-	-	2	-	-	-	-	-	-	3	3	1	1	1
CO3	3	3	-	-	-	2	-	-	-	-	-	-	3	3	1	1	1
CO4	3	3	-	-	-	2	-	-	-	-	-	-	3	3	1	1	1
Average	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**	**1**	**1**

High-3, Medium-2, Low-1, No Correlation-0

Elective Papers

(VIII Semester)

MAT-001-DE-4810
NUMERICAL METHODS
Credit: 4 (L-3, T-0, P-1)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)
Practical: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Find the root(s) of nonlinear equations up to a certain level of precision, and understand the techniques of numerical interpolations.
CO2: Understand the techniques of numerical differentiation and integration.
CO3: Construct best approximation for a given set of data through curve fitting technique.
CO4: Solve differential equations using numerical methods.

Unit I: Computational errors, roots of algebraic and transcendental equations, Bisection method, Regular-Falsi method, Secant method and Newton-Raphson method. System of linear equations; Gaussian elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss-Seidel method **(Contact Hours: 12)**

Unit II: Finite differences, relation between finite differences and derivatives of functions, factorial notation. Newton's forward and backward interpolation formula, Newton's and Lagrange's divided difference formulae, Gauss's, Stirling's and Bessel's interpolation formulae. Curve fitting: Least square method, fitting of straight line, power function, polynomial functions, and exponential functions. **(Contact Hours: 18)**

Unit III: Numerical differentiation, numerical integration, quadrature formulas, Trapezoidal rule, Weddle's rule, Simpson's one third and three-eight rule. **(Contact Hours: 10)**

Unit IV: Eigenvalue problem: Power method, Householder method, Reduction to tridiagonal form, QR method. Numerical Solution of Differential: Euler's Method, RK method of 2^{nd} and 4^{th} orders . **(Contact Hours: 10)**

Unit V: Practical in consonant with Unit I - IV. **(Contact Hours: 10)**

Books Recommended:

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, (2007).
2. S. S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India, (2005).
3. K. E. Atkinson, An Introduction to Numerical Analysis, Wiley India Private Limited; Second edition (2008).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	2	3	-	2	-	-	-	-	3	3	1	1	0
CO2	3	3	-	-	2	3	-	2	-	-	-	-	3	3	1	1	0
CO3	3	3	-	-	2	3	-	2	-	-	-	-	3	3	1	1	0
CO4	3	3	-	-	2	3		2					3	3	1	1	2
Average	**3**	**3**	**-**	**-**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**1**	**1**	**2**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-DE-4820
LINEAR ALGEBRA
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Learn the connection of matrices with linear transformations, the concept of characteristic and minimal polynomials, and their properties.
CO2: Understand canonical forms for linear transformations and the underlying concepts.
CO3: Understand the theory of inner product spaces and bilinear forms.

Unit-I: Linear transformations and its matrices, determination of linear transformation for a given matrix and bases, isomorphism between algebra of linear transformations and family of matrices, characteristic and minimal polynomial, Cayley-Hamilton theorem for linear operator.
(Contact Hours: 15)

Unit-II: Canonical forms: invariant subspaces, invariant direct sum decomposition, primary decomposition theorem, cyclic subspaces, rational canonical form, Jordan canonical form.
(Contact Hours: 15)

Unit-III: Inner product spaces, projections and its applications, orthogonal vectors and subspaces, orthogonal bases, Gram-Schmidt process, adjoint, self-adjoint, normal, and unitary operators.
(Contact Hours: 15)

Unit-IV: Bilinear forms, the matrix of a bilinear form, Hermitian forms, orthogonality, classification of bilinear forms, real quadratic form, matrix of a quadratic form, criterion positive definiteness. (**Contact Hours: 15**)

Books Recommended:

1. K. Hoffman and R. Kunze, *Linear Algebra*, Prentice Hall of India (2015).
2. S. Lipschutz and M. Lipson, *Schaum's outline of Linear Algebra*, Tata McGraw Hill (2017).
3. G. Strang, *Linear Algebra and its Applications*, Cengage Learning, India Edition (2005).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	2	2	-	-	-	-	-	-	3	3	3	1	1
CO2	3	3	1	-	2	2	-	-	-	-	-	-	3	3	3	1	1
CO3	3	3	1	-	2	2	-	-	-	-	-	-	3	2	2	1	1
Average	**3**	**3**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.7**	**2.7**	**1**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-101-DE-4830
Tensor Calculus
Credit: 4 (L-3,T-1, P-0)
Total Contact Hours: 60
Total Marks: 100 (Theory: 80, Internal Assessment:20)

Course Outcomes: This course will enable the students to:

CO1: Develop the idea of tensors, quotient law and algebra of tensors with respect to transformation of coordinates.

CO2: Learn the concept of covariant derivatives, Christoffel symbols and laws of transformation with applications in theoretical physics and engineering.

CO3: Learn the notion of curvilinear, spherical and cylindrical coordinate system, parallel vector field, Curvature tensor, Ricci tensor, Intrinsic differentiation, Geodesics and their applications in relativity theory.

Unit-I: Einstein Summation convention, Kronecker symbols, n-dimensional space S_n, transformation of coordinates in S_n, Invariants, Covariant and Contravariant vectors, Covariant, contravariant and mixed tensors, algebra of tensors, symmetric and skew-symmetric tensors, outer and inner multiplication, contraction of tensors, quotient law, reciprocal tensor.
(Contact Hours: 15)

Unit-II: Riemanian Space, line element and metric tensor, inclination between two vectors, orthogonal vectors, Christoffel symbols of 1^{st} and 2^{nd} kind with their properties, laws of transformation of Christoffel symbols of 1^{st} and 2^{nd} kind. **(Contact Hours: 10)**

Unit-III: Covariant differentiation of tensors, covariant differentiation of sum, difference and product of tensors, Ricci's theorem, Gradient, divergence, curl and Laplacian, conservative vector, irrotational Vector, Riemann Christoffel curvature tensor and their properties, Ricci tensor, Intrinsic differentiation, Geodesics. **(Contact Hours: 15)**

Unit-IV: Curvilinear coordinate system in E_3: line element, length of vector, angle between two vectors in a curvilinear coordinate system, basis, reciprocal basis, covariant and contravariant vector in E_3, spherical and cylindrical coordinate systems, curves in E_3, parallel vector field along a curve in E_3, parallel vector space in Riemanian Space, parallel vector field in a surface of a Riemanian Space, Serret-Frenet formulas. **(Contact Hours: 20)**

Recommended Books:

1. D. C. Kay, *Theory and problems of Tensor Calculus*, Revised Edition, McGraw Hill, (2011).
2. A. Lichnerowicz, *Elements of Tensor Calculus*, Dover Publications Inc. (2016).
3. U. C. Dey, A. A. Shaikh and J. Sengupta, *Tensor Calculus*,2^{nd} Edition, Alpha Science International Ltd, (2008).

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	2		-	-	-	-	-	-	3	1	2	0	1
CO2	3	3	-	-	2		-	-	-	-	-	-	3	2	2	0	1
CO3	3	3	-	-	2		-	-	-	-	-	-	3	3	2	0	1
Average	**3**	**3**	**-**	**-**	**2**		**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**0**	**1**

MAT-001-DE-4840

DIFFERENTIAL GEOMETRY

Credit: 4 (L-3, T-1, P-0)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:

CO1: Acquaint students with basic elements of differential geometry of manifold.

CO2: Learn basic concepts of Planetary motion, Celestial Sphere, equation of normal, binomial, tangent to a curve and time to connect with Universe.

CO3: Understand about different geometrical figures and their representation in mathematical equation.

CO4: Pursue research and solve real life problems.

Unit – I: Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret – Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. **(Contact Hours: 25)**

Unit – II: Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines. **(Contact Hours: 25)**

Unit – III: Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. **(Contact Hours: 10)**

Books Recommended:

1. T. J. Willmore, *An Introduction to Differential Geometry*, Dover Publications, (2012).

2. B. O. Neill, *Elementary Differential Geometry*, 2nd Ed., Academic Press, (2006).

3. S. Lang, *Fundamentals of Differential Geometry*, Springer, (2010).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	2	1	-	-	-	-	-	-	2	3	2	2	2
CO2	3	3	1	-	2	1	-	-	-	-	-	-	2	3	2	2	2
CO3	3	3	1	-	2	1	-	-	-	-	-	-	2	3	2	2	2
CO4	3	3	1	-	2	1	-	-	-	-	-	-	2	3	2	2	2
Average	**3**	**3**	**1**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**2**	**2**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-DE-4850
HYDRODYNAMICS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:

CO1: Understand the distinction between ideal and real fluids along with their properties and analyze and interprets fluid flow fields.

CO2: Analyze the behavior of Newtonian and non-Newtonian fluids and their applications in different engineering sciences.

CO3: Explain the pressure characteristics of gases, atmospheric dynamics and relation between pressure, density and temperature.

CO4: Understand the underlying concepts of kinematics of fluid flow.

Unit – I: Introduction: Definition of ideal and real fluids, homogeneous and heterogeneous fluids, pressure, density, viscosity, Newtonian and non-Newtonian fluids, scalar and vector fields, flow fields, two dimensional and three dimensional flows, antisymmetric flow, line of flow.
(Contact Hours: 15)

Unit – II: Gas: Pressure of gases, the atmosphere, relation between pressure, density and temperature, pressure in an isothermal atmosphere, adiabatic gas, atmosphere in convective equilibrium, rotating fluids and examples. **(Contact Hours: 15)**

Unit – III: Kinematics of Fluid: Pressure, density, viscosity, Newtonian and non-Newtonian fluids, scalar and vector fields, flow field, description of fluid motion, Lagrangian method, Eulerian method, relation between Eulerian and Lagrangian methods, variation of flow parameters in time and space, steady and unsteady flow, uniform and non-uniform flows, material derivative and acceleration, temporal (local) derivative, convective derivative, rotational, irrotational flow and velocity potential, velocity of a fluid particle at a point and examples. **(Contact Hours: 30)**

Books Recommended:

1. M. D. Raisinghania, *Fluid Dynamics*: With Hydrodynamics, S Chand & Co. 5th edition (2003).
2. H. Lamb, *Hydrodynamic*s, Dover Publications Inc.; 6th edition (2009).
3. S. Swarup, *Hydrodynamics*, Krishna Prakashan Mandir, Meerut (2016).
4. B. D. Sharma, *Hydrostatic,* Krishna Prakashan Mandir, Meerut (2020).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	2	2	-	-	-	-	-	-	3	3	2	2	2
CO2	3	3	1	-	2	2	-	-	-	-	-	-	3	3	2	2	2
CO3	3	3	1	-	2	2	-	-	-	-	-	-	3	3	2	2	2
CO4	3	3	1	-	2	2	-	-	-	-	-	-	3	3	2	2	2
Average	**3**	**3**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**2**	**2**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001- DE -4860
COMPLEX ANALYSIS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:
CO1: Understand the significance of Cauchy's integral formula of complex integration and applications.
CO2: Know different types of singular points and their applications.
CO3: Understand the theory of calculus of residues and its applications in evaluating contour integrals and expansion theorem.
CO4: Understand the concept of conformal mappings and bilinear transformations.

Unit-I: Cauchy's inequality, Liouville's theorem and applications, Gauss Mean value theorem, Maximum modulus theorem and minimum modulus principle, and applications.
(Contact Hours: 15)

Unit-II: Zeros of analytic functions, singularities, poles, types and properties of singularities, singularities at infinity Laurent's expansion theorem, rational and meromorphic function, argument principle, Rouche's theorem. **(Contact Hours: 15)**

Unit-III: Residues and their calculus, Cauchy's residue theorem, evaluation of definite integrals, special theorems used in evaluating integrals, Mittag-Leffler's expansion theorem.
(Contact Hours: 15)

Unit-IV: Elementary Transformation: rotation, translation, stretching, inversion, Jacobian of a transformation, conformal and isogonal transformations, bilinear transformation, cross-ratio, fixed points and normal form of bilinear transformation, inverse points and critical points. Some special bilinear transformations: real axis onto itself, half plane onto unit circular disc, circular disc onto circular disc. **(Contact Hours: 15)**

Books Recommended:

1. J. W. Brown and R. V. Churchill: *Complex Variables and Applications*, Tata McGraw Hill (2021).
2. E. G. Milewski, *The Complex Variables Problem Solver*, Research and Education Association, New York (1992).
3. M. R. Spiegel, *Complex variables*, Schaum's Series, Tata McGraw Hill (2017).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	2	2	-	-	-	-	-	-	3	2	2	1	0
CO2	3	3	1	-	2	2	-	-	-	-	-	-	3	2	2	1	1
CO3	3	3	1	-	2	2	-	-	-	-	-	-	3	2	2	3	1
CO4													3	2	2	3	1
Average	**3**	**3**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**2**	**0.8**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-DE-4870
DIFFERENTIAL EQUATIONS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Understand existence and uniqueness of solution of differential equations before solving it.
CO2: Solve different types of partial differential equations.
CO3: Solve different types of boundary value problems.

Course Learning Outcomes: The course will enable students to solve differential equations and construct and solve models related physical phenomena through mathematical equations.

Unit-I: IVP of first order ODE: Picard's method of successive approximation, Existence theorems of first order linear ODE, Wronskian**.** **(Contact Hours: 15)**

Unit- II: Linear partial differential equation of first order: Various forms of first order partial differential equations, Lagrange's method.
Non-linear partial differential equations of first order: Use of standard forms for solution of non-linear partial differential equations. Charpit's method. **(Contact Hours: 15)**

Unit-III: PDE of 2nd order: Second order Differential equations with constant and variable coefficients, Canonical Forms. **(Contact Hours: 15)**

Unit-IV: Strum-Liouville Problems: Orthogonality of characteristic functions, Expansion of a function in Series of Orthonormal Functions. **Boundary Value Problems:** Heat Equation, Wave Equation, Laplace Equation, Examples. **(Contact Hours: 15)**

Books Recommended:

1. S. L. Ross, *Differential Equations*, 3rd Edition, John Wiley & Sons, Inc. (2007).
2. I. Snedden, *Elements of Partial Differential Equations*. Tata McGraw Hill (2006).
3. M. D. Raisinghannia, *Advanced Differential Equations*, S. Chand. & Co. Ltd. (2018).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	2	2	-	-	-	-	-	-	3	3	2	2	3
CO2	3	3	-	-	2	2	-	-	-	-	-	-	3	3	2	2	3
CO3	3	3	-	-	2	2	-	-	-	-	-	-	3	3	2	2	3
Average	**3**	**3**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**2**	**3**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-DE -4880
Hydrostatics
Credit:4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:

CO1: Understand the basic concepts of hydrostatics.

CO2: Learn various applications of hydrostatic pressures in physical sciences.

CO3: Have a deeper understanding of conditions of equilibrium and stability of floating bodies.

Unit I: Fluid Pressure: Introduction, fluid pressure and related theorems, density and specific gravity, theorems on fluid pressure under gravity, rate of variation of pressure, differential equation of pressure, condition of equilibrium, equi-pressure surfaces and lines of force, curves of equi-pressure, equi-density and their examples. **(Contact Hours: 25)**

Unit 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 and their examples, thrust on curved surfaces with examples.
(Contact Hours: 25)

Unit III: Equilibrium and Stability of Floating Bodies: Condition of equilibrium of floating bodies, examples, unstable and neutral equilibrium, determination of meta-centre with examples.
(Contact Hours: 10)

Books Recommended:

1. M. Ray and H. S. Sharma, *A Textbook of Hydrostatics*. S. Chand & Company Ltd. (2000).

2. A. S. Ramsey, Hydrostatics, Cambridge University Press (2017).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	1	-	-	-	-	-	-	3	2	1	0	1
CO2	3	3	-	-	-	1	-	-	-	-	-	-	3	2	1	0	1
CO3	3	3	-	-	-	1	-	-	-	-	-	-	3	2	1	0	1
Average	**3**	**3**	-	-	-	**1**	-	-	-	-	-	-	**3**	**2**	**1**	**0**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT- 001-DE -4890

PROBABILITY AND STATISTICS

Credit: 4 (L-3, T-1, P-0)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:

CO1: Learn about basic concepts of probability, probability density and moment generating functions.

CO2: Learn about distributions to study the joint behavior of two random variables.

CO3: Know about probability distributions such as Binomial, Poisson, and Normal distributions and their properties.

CO4: Intend to several examples and exercises that blend their everyday experiences with their scientific interests.

Unit-I: Various measures of central tendency, dispersion, skewness and kurtosis for continuous distributions. sample space, events, probability axioms, addition law of probability, conditional probability, multiplication law of probability and independent events, Baye's theorem.

(Contact Hours: 15)

Unit-II: Random variable (discrete and continuous), cumulative distribution function, probability mass/density functions, probability distributions and properties of Binomial distribution, Poisson distribution and Normal distribution. **(Contact Hours: 15)**

Unit-III: Joint cumulative distribution function, joint probability density functions, marginal and conditional distributions. **(Contact Hours: 15)**

Unit-IV: Mathematical expectation, moments, moment generating function, expectation of function of two random variables, conditional expectations, independent random variables, characteristic function. **(Contact Hours: 15)**

Books Recommended:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons (2020).

2. M. Spiegel , J. Schiller , R. A. Srinivasan and D. Goswami, *Probability and Statistics*, McGraw Hill education; 3rd edition (2017).

3. R. V. Hogg, J. W. McKean and A.T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, (2020).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	1	3	-	-	-	-	-	-	3	3	2	3	2
CO2	3	3	-	-	1	3	-	-	-	-	-	-	3	3	2	3	2
CO3	3	3	-	-	1	3	-	-	-	-	-	-	3	3	2	3	2
CO4	3	3	-	-	1	3							3	3	2	3	2
Average	**3**	**3**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**2**

High-3, Medium-2, Low-1, No Correlation-0

MINOR COURSES

MAT-001-MC-1110
DIFFERENTIAL AND INTEGRAL CALCULUS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Understand the concepts of limit, continuity and derivatives of functions.
CO2: Understand different theorems related to continuous functions and their applications.
CO3: Understand basic concept of integration and its applications.

Unit-I: Limit and continuity, types of discontinuities, differentiability of functions, successive differentiation, Leibnitz's theorem, partial differentiation, Euler's theorem on homogeneous functions. **(Contact Hours: 20)**

Unit-II: Tangents and normals, Rolle's theorem, Mean value theorems, Taylor's series, Maclaurin's series, maxima and minima, indeterminate forms. **(Contact Hours: 20)**

Unit-III: Integration by partial fractions, integration of rational and irrational functions, properties of definite integrals, reduction formulae for integrals, rectification of plane curves, area under plane curves, volume and surface areas of solid of revolution. **(Contact Hours: 20)**

Books Recommended:

1. T. G. B. Thomas and R. L. Finney, *Calculus* (13th ed). Pearson Education, Delhi. (2017).
2. H. Anton, I. Bivens and S. Davis, Stephen. *Calculus* (10th ed). Wiley India Pvt. Ltd., Delhi (2015).
3. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand & Co Ltd; (1942).
4. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand & Co Ltd; (2005).
5. B. C. Das and B. N. Mukherjee, *Differential Calculus*. U.N. Dhur & Sons Pvt. Ltd. (2019).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	1	-	-	-	-	-	-	3	2	0	1	0
CO2	3	3	1	1	-	1	-	-	-	-	-	-	3	3	0	1	0
CO3	3	3	1	1	-	1	-	-	-	-	-	-	3	3	0	1	0
Average	**3**	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.7**	**0**	**1**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-MC-1210

ORDINARY DIFFERENTIAL EQUATIONS

Credit: 4 (L-3, T-1, P-0)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable the students to:

CO1: Learn basics of differential equations.

CO2: Learn different methods for solving differential equations.

CO3: Learn the method of variation of parameters.

Unit-I: Order and degree of ordinary differential equation, formation of differential equation, general solution, variable separable form, homogeneous differential equations, equation reducible to homogeneous equation from. **(Contact Hours: 20)**

Unit-II: Exact differential equations, equation reducible to exact form, integrating factors, rules to find an integrating factor, linear equation (including Bernoulli's equation and other simple cases reducible to reducible to linear), first order second degree equations. **(Contact Hours: 20)**

Unit-III: Linear differential equations second order with constant coefficients, linear homogenous equations with constant coefficients, linear non-homogenous equations, the method of variation of parameters, **(Contact Hours: 20)**

Books Recommended:

1. S. L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, (2007).
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, (2006).
3. M. D. Raisinghannia, *Ordinary and Partial Differential Equation.* S. Chand and Co. (2024).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	1	-	-	-	-	-	-	3	2	1	1	0
CO2	3	3	-	-	-	1	-	-	-	-	-	-	3	2	1	1	0
CO3	3	3	-	-	-	1	-	-	-	-	-	-	3	2	1	1	0
Average	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**1**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-MC-2310
MODERN ALGEBRA
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Recognize fundamental algebraic structures like group, rings, integral domain and field.
CO2: Understand the concepts of group homomorphism and isomorphism.
CO3: Understand the basics of linear spaces and mappings defined on linear spaces.

Unit-I: Groups and subgroups, properties of groups, cyclic groups and its properties, normal subgroup, quotient groups. **(Contact Hours: 15)**

Unit-III: Group homomorphisms, definition and examples, properties of homomorphisms, fundamental theorem on group homomorphisms, isomorphism. (**Contact Hours: 15)**

Unit-IV: Rings, definition and examples, commutative and non-commutative rings, subrings and ideals, quotient ring, integral domains, division rings and fields (definitions and examples).
(**Contact Hours: 10)**

Unit-IV: Vector spaces, subspaces, algebra of subspaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, linear transformations (Definitions and examples). **(Contact Hours: 20)**

Books Recommended:

1. I. N. Herstein, *Topics in Algebra*, Wiley; 2nd edition (2006).
2. S. Singh and Q. Zameerudin, *Modern Algebra*, Vikas Publishing House Pvt Ltd; (2006).
3. S. Lipschutz and M. Lipson, *Linear Algebra*, McGraw Hill Education (2017).
4. W. J. Gilbert, *Modern Algebra with Applications*, Wiley (2008).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	1	-	-	-	-	-	-	3	2	0	0	0
CO2	3	3	-	-	-	1	-	-	-	-	-	-	3	2	0	0	0
CO3	3	3	-	-	-	1	-	-	-	-	-	-	3	2	0	0	0
Average	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**0**	**0**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-MC-2410

FINITE DIFFERENCES AND NUMERICAL METHODS

Credit: 4 (L-3, T-0, P-1)

Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Learning Outcomes: The course will enable students to:

CO1: Know interpolation techniques to compute the values for a tabulated function at points.

CO2: Understand and analyze various numerical differentiation and integration methods.

CO3: Understand some numerical techniques to find the root(s) of nonlinear equations up to a certain level of precision and system of linear equations.

Unit I: Differences, Relation between differences and derivatives of polynomials, Factorial notation, Newton's forward and backward interpolation formula, Divided differences: Newton's and Lagrange's divided differences formulae. **(Contact Hours: 15)**

Unit II: Numerical differentiation. Numerical integration: General quadrature formula for equidistant ordinates, Trapezoidal rule, Simpson's one-third and three-eight rule. **(Contact Hours: 15)**

Unit III: Errors in Numerical computation, Polynomial and Transcendental equations, nature and location of roots of Polynomial equations, Methods of solving transcendental equations: Bisection method, Regular Falsi method, Newton-Raphson method. **(Contact Hours: 15)**

Unit-IV: System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss-Seidel method. **(Contact Hours: 15)**

Books Recommended:

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New age International Publisher, India, (2007).

2. K. Atkinson, *An Introduction to Numerical Analysis* Wiley Publications, (2008).

3. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, (2007).

4. S. S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice hall of India, (2022).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	1	-	-	-	-	-	-	3	3	0	0	0
CO2	3	3	-	-	-	1	-	-	-	-	-	-	3	3	0	0	0
CO3	3	3	-	-	-	1	-	-	-	-	-	-	3	3	0	0	0
Average	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**0**	**0**	**0**

MAT-001-MC-3510
STATISTICS AND PROBABILITY
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Achieve basic knowledge on various components such as probability, probability density and moment generating functions, correlations and so on.
CO2: Learn about distributions to study the joint behavior of two random variables.
CO3: Know about distributions such as Binomial, Poisson, and Normal distributions and their properties.
CO4: Acquaint students with advancement in statistical theory and applications in real situation.

Unit I: Frequency distribution, measures of central tendency, measures of dispersion: standard deviation, quartile deviation, co-efficient of variation, skewness and kurtosis **(Contact Hours: 15)**

Unit II: Correlation and regression; Karl Pearson's coefficient of correlation, Spearman rank correlation co-efficient, regression lines and equations **(Contact Hours: 15)**

Unit III: Random variable, random experiment, sample space, events, mathematical definition of probability, statistical probability, axiomatic approach of probability, conditional probability, independent events, multiplication theorem of probability for independent events, Baye's theorem. **(Contact Hours: 20)**

Unit IV: Theoretical probability distribution, binomial, Poisson and normal distribution and their properties. **(Contact Hours: 10)**

Books Recommended:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons (2020).
2. M. Spiegel , J. Schiller , R. A. Srinivasan and D. Goswami, *Probability and Statistics*, McGraw Hill education; 3rd edition (2017).
3. R. V. Hogg, J. W. McKean and A.T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, (2020).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	2	-	-	-	-	-	-	3	3	0	0	0
CO2	3	3	-	-	-	2	-	-	-	-	-	-	3	3	0	0	0
CO3	3	3	-	-	-	2	-	-	-	-	-	-	3	3	0	0	0
Average	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**0**	**0**	**0**

MAT-001-MC-3610
DISCRETE MATHEMATICS
Credit: 4 (L-3, T-1, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course learning outcomes: The course will enable students to:
CO1: Understand the notion of counting principle and recurrence relations.
CO2: Understand the fundamentals of mathematical logic.
CO3: Understand the concept of partially ordered sets and lattices and their properties.
CO4: Understand basics of Boolean algebra and related results.

Unit I: Principle of inclusion and exclusion, Pigeonhole principle, generating functions, partitions, recurrence relation, generating function from recurrence relation. **(Contact Hours: 15)**

Unit II: Introduction to mathematical logic, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contrapositive and inverse propositions and precedence of logical operators. propositional equivalence: logical equivalences. predicates and quantifiers: introduction, quantifiers, binding variables and negations.
(Contact Hours: 15)

Unit III: Partial ordering, properties of ordered sets, order isomorphism, Hasse-diagrams, dual of an ordered set, duality principle, maximal and minimal elements. lattices, sublattices, products and homomorphisms, modular and distributive lattices. **(Contact Hours: 15)**

Unit IV: Boolean algebras, De-morgan's laws, Boolean homomorphism, Boolean function, sum of product and product of sums form, normal forms and canonical forms, logic gates and logic circuits.
(Contact Hours: 15)

Books Recommended:

1. S. K. Sarkar, *A textbook of Discrete Mathematics*, S Chand & Sons (2005).
2. S. Lipschutz and M. L. Lipson, *Discrete Mathematics*, Schaum's series, Tata McGraw Hill Edition, 3rd edition (2017).
3. R. P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, (2019).
4. S. B. Bhoi, A Textbook of Logic and Sets, Educreation Publishing (2018).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO2	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	1	0
CO3	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO4	3	3				2							3	2	0	1	0
Average	**3**	**3**	**-**	**-**	**-**	**2**	-	-	-	-	-	-	**3**	**2**	**0**	**0.5**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-RC-4710
RESEARCH METHODOLOGY
Credit: 4 (L-4, T-0, P-0)
Total Contact Hours: 60
Theory: 100 (End Semester Theory: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Understand various elements involved in formulation of research problems.
CO2: Understand the importance of literature review and identifying the gaps in research problems.
CO3: Understand different aspect involved in writing research papers, research proposal for grants, and research database accounts.

Unit-I: Importance of Scientific Research: Philosophy and history of mathematics, formulation of research problem, significance of hypothesis and null hypothesis, formulation of objectives, quantitative and qualitative research, research tools–online and open access journals, primary and secondary sources, web sources, critical literature review. **(Contact Hours: 15)**

Unit-II: Importance of Literature Review: Structure and components of scientific and technical report writings, survey of a research topic, needs of citations in literature reviews, uses of pictures and graphs in texts, bibliography, citation and acknowledgement in a research paper, survey article and thesis writing. **(Contact Hours: 15)**

Unit-III: Importance of Reviewing a paper: Role of a supervisor, publishing a research article, research article-review, funding agencies, writing of research proposal for financial grant, similarity in research articles, copyright issues of publishing houses, necessity of account in Orcid, Google scholar, Research gate, Scopus and Web of science. **(Contact Hours: 15)**

Unit-IV: Research Paper Writing: Preparation of a research paper for publication-Title, Abstract, Importance of Keywords and AMS subject classifications, Results, Findings & Discussions. Conference presentation. (**Contact Hours: 15**)

Books Recommended:

1. N. J. Higham, *Handbook of Writing for the Mathematical Sciences,* SIAM (2020).
2. D. E. Knuth, Tracy Larrabee and P. M. Roberts, *Mathematical Writing,* Mathematical Association of America (1989).
3. N. E. Steenrod, P. R. Halmos, M. M. Schiffer and J. A. Dieudonne, *How to Write Mathematics*, American Mathematical Society (1973).
4. L. C. Perelman, *The Mayfield Technical Scientific Writing*, Tata James parade & McGraw Hills (2001).
5. C. R. Kothari and G. Garg, *Research Methodology*, New Age International Pvt. Ltd. Pub. (2023).
6. G. J. Alred, W. E. Oliu and C. T. Brusaw: Handbook of Technical Writing, Bedford/St. Martin's Press (2018).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3
CO2	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3
CO3	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3
Average	**-**	**3**	**3**	**2**	**2**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**0**	**0**	**0**	**0**	**3**

MAT-001-RC-4810
RESEARCH AND PUBLICATION ETHICS
Credit: 4 (L-3, T-0, P-1)
Total Contact Hours: 60

Theory: 100 (End Semester: 80, Internal Assessment: 20)
Practical-100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable student to:
CO1: Understand Philosophy and Ethics of scientific research and research misconducts.
CO2: Understand the ethics involved in research publications, best practices and different conflict of interests.
CO3: Acquaint with open access journals, databases and research metrics, and use of different software for plagiarism check.

Unit I: Philosophy and Ethics: Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgments and reactions.
Scientific Conduct: Ethics with respect to science and research - Intellectual honesty and research integrity Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data.
(Contact Hours: 15)

Unit II: Publication Ethics: Publication ethics: definition, introduction and importance - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publisher and journals. **(Contact Hours: 10)**

Unit III: Open Access Publishing: Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggested, etc.
Publication Misconduct:
1. Group Discussion: Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad.
2. Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools.
Databases and Research Metrics
1. Databases: Indexing databases, Citation databases: Web of Science, Scopus, etc.
2. Research Metrics: Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics. **(Contact Hours: 20)**

Practical: Practical in consonant with Unit- III. **(Contact Hours: 15)**

Books Recommended:
1. A. Bird, *Philosophy of Science*, Routedge (2006).
2. A. Mac lntyre, *A Short History of Ethics*, Notre Dame Press (2002).
3. P. Chaddha, *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN: 9789387480865 (2018).
5. D. B. Resnik, *What is ethics in research & why is it important*. National Institute of Environmental Health Sciences, 1-10 (2011).
6. J. Becall, *Predatory publishers are corrupting open access*, Nature, 489(7415), 179-179 (2012).
7. S. K. Yadav, *Research and Publication Ethics,* Springer Cham (2023).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3
CO2	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3
CO3	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3

Average	-	3	3	2	2	-	-	2	-	2	-	-	0	0	0	0	3

High-3, Medium-2, Low-1, No Correlation-0

SKILL ENHANCEMENT COURSES (SEC)

MAT-001-SE-0010
FUNDAMENTALS OF COMPUTERS
Credit: 3 (L-2, T-1, P-0)
Total Contact Hours: 45
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:
CO1: Understand how data are stored in computer.
CO2: Use technology ethically, safely, securely, and legally.
CO3: Identify and analyze computer hardware, software, and network components.

Unit I: Number systems: Binary Number System, Octal number system, Hexadecimal number system, Inter conversion between number systems, Binary arithmetic. **(Contact Hours: 15)**

Unit-II: Introduction to Computer, Block Diagram of Computers, generations and classification of Computers, System Hardware, Memory, Input and Output Devices, Interaction between User and Computer. Operating System: types and functions of Operating Systems, Translators: Assembler, compiler and interpreter. **(Contact Hours: 15)**

Unit-III: Introduction to Internet, WWW and Web Browsers: Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website. **(Contact Hours: 15)**

Books Recommended:

1. E. Balaguruswamy, *Fundamentals of Computers*, McGraw Hill Education India, (2009).
2. A. Goel, *Computer Fundamentals*, Pearson Education India, (2010).
3. V. Rajaraman and N. Adabala, *Fundamentals of computers*, 6th Ed., Prentice Hall India Learning, (2014).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	-	-	-	1	-	-	2	-	-	-	-	0	1	0	1	1
CO2	1	-	-	-	1	-	-	2	-	-	-	-	0	1	0	1	1
CO3	1	-	-	-	1	-	-	2	-	-	-	-	0	1	0	1	1
Average	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**0**	**1**	**0**	**1**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-SE-0020
PROGRAMMING IN C
Credit: 3 (L-0, T-0, P-3)
Total Contact Hours: 45
Practical: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable students to:
CO1: Learn coding with C-Programming.
CO2: Code a program on their own.
CO3: Solve complex problems with C-Programming.

Unit I: Introduction to C Programming: Basic structure, constants, variables, Data types, operators and expressions, Control statements: if statement, switch statement, conditional operator statement and goto statement. Looping, nested loops continue and break statements. Arrays and functions. **(Contact Hours: 45)**

List of Practical:

1. To find Addition, subtraction, multiplication and division of numbers.
2. To find factorial and sum of digits of positive integers, average, standard deviation.
3. To check if the number is even, odd, and prime.
4. To read and find addition, subtraction and product of matrices.
5. To solve linear and quadratic equations.
6. To display the Fibonacci series and find sum of different series.
7. To find greatest among the numbers.

Books Recommended:

1. E. Balaguruswamy, *Programming in ANSI C*, 8th Ed., McGraw Hill Education India, (2019).
2. P. Dey and M. Ghosh**,** *Computer fundamentals and programming in C*,2nd Ed**.**, Oxford University Press, (2013).
3. V. Gupta, *Computer Concepts and C Programming*, Dreamtech Press, (2014).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
CO2	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
CO3	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
Average	**2**	**2**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**0**	**1**	**1**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-SE-0030
INTRODUCTION TO MATHEMATICA
Credit: 3 (L-0, T-0, P-3)
Total Contact Hours: 45
Practical: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: The course will enable students to:
CO1: Learn the coding language *Mathematica.*
CO2: Write codes for performing basics mathematical computations of functions, differentiation and integration of functions.
CO3: Write codes for displaying matrix and its operations.
CO4: Write codes to solve of linear, simultaneous equations, differential equations, linear programming problems.

Unit-I: Introduction to *Mathematica* and the Wolfram Language, basic components of *Mathematica* and entering inputs, variables and functions, polar coordinates, complex numbers, trigonometric, logarithmic and exponential functions, plotting of functions in 2d and 3d, numerical and symbolic computations.

Evaluation of limit, derivatives, maximum and minimum values of functions. Indefinite and definite integrations of functions, sequence and series, matrix display and calculation of transpose, determinant, inverse, rank, characteristics polynomial, eigenvalues, eigenvectors and trace, plotting of curves, solution of algebraic equation, simultaneous linear equations and differential equations.
(Contact Hours: 45)

Books Recommended:

1. Eugene Don, *Mathematica*, Schaum's Outline of Mathematica, 3rd Edition (2018).

2. B. F. Torrence and E. A. Torrence: The Student's Introduction to MATHEMATICA, Cambridge University Press; 2nd edition (2009).

3. Stephen Wolfram, The MATHEMATICA (R) Book Cambridge University Press; (1999).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
CO2	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
CO3	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
CO4	2	2	1	2	1	-	-	2	-	-	-	-	1	2	0	1	1
Average	**2**	**2**	**1**	**2**	**1**	-	-	**2**	-	-	-	-	**1**	**2**	**0**	**1**	**1**

High-3, Medium-2, Low-1, No Correlation-0

Multidisciplinary Courses

MAT-001-MD-0010
ELEMENTARY MATHEMATICS-I
Credit: 3(L-2, T-1, P-0)
Total Contact Hours: 45
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Understand basics of matrices, determinants, and their properties.
CO2: Test consistency of system of linear equations by using matrix properties and to find their solutions.
CO3: Understand basics of set theory and properties, and permutation and combination.

Unit I: Matrices: Matrices, types of matrices. Determinants, rank of a matrix, inverse of a matrix, and invariance of rank under elementary transformations. Reduction to normal form and Echelon forms. **(Contact Hours: 20)**

Unit-II: Consistency of system of linear equations in matrix form $Ax = b$ and their solutions. **(Contact Hours: 10)**

Unit III: Sets, relations, congruence and equivalence relation, functions; Permutation and combination, **(Contact Hours: 15)**

Books Recommended:

1. J. Hall and P. Knight, *Higher Algebra* Arihant Publications; 7th edition (2023).
2. R. Bronsons, Matrix Operations, McGraw-Hill Education; 1st edition (2011).
3. I. N. Herstein, *Topics in Algebra*, Wiley; (2022).
4. V. K. Khanna and S. K. Bhambri, *A Course in Abstract Algebra*, Vikas Pub. House. Pvt Ltd. (2017).
5. C. Meyer, *Matrix Analysis and Applied Linear Algebra*. Society for Industrial and Applied Mathematics (SIAM), (2000).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO2	2	2	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO3	2	2	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
Average	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**0**	**0**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-MD-0020
ELEMENTARY MATHEMATICS-II
Credit: 3(L-2, T-1, P-0)
Total Contact Hours: 45
Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Outcomes: This course will enable the students to:
CO1: Understand the concepts of two-dimensional coordinate geometry.
CO2: Understand the concepts of continuous and differentiable functions.
CO3: Find derivatives and integrals of different functions, and also apply them in problem solving.

Unit I: Two-dimensional coordinate geometry: Distance between two points, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two-point form, intercepts form and normal form. General equation of a line. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line. **(Contact Hours: 15)**

Unit II: Differential Calculus: Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function. Derivatives of exponential, logarithmic functions. Derivative of functions expressed in parametric forms. Second order derivatives. Increasing/decreasing functions, Maxima and minima of function of single variable.
Integral calculus: Integration of a variety of functions by substitution, by partial fractions and by parts. Definite integrals as a limit of a sum. Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. (**Contact Hours: 30)**

Books Recommended:

1. R. M. Khan, *Analytical Geometry of Two and Three dimension and vector analysis*. New Central Book Agency (2022).
2. S. B. Sengupta, *Coordinate geometry and vector analysis*, Joydurga Library Pvt. Ltd. (2021).
3. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand & Co Ltd; 15th edition (2005).
4. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand & Co Ltd; 35th edition (2005).
5. B. C. Das and B. N. Mukherjee, *Differential Calculus*. U.N. Dhur & Sons Pvt. Ltd.; 57th edition (2019).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO2	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO3	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
Average	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**0**	**0**	**0**

High-3, Medium-2, Low-1, No Correlation-0

MAT-001-MD-0030

BASIC STATISTICS AND PROBABILITY

Credit: 3 (L-2, T-1, P-0)

Total Contact Hours: 45

Theory: 100 (End Semester: 80, Internal Assessment: 20)

Course Learning Outcomes: This course will enable the students to:

CO1: Learn about basics of frequency distributions, and joint behavior of two random variables.

CO2: Learn about basic concepts of probability theory and important theorems.

CO3: Learn about theoretical probability distributions such as Binomial, Poisson, and Normal distributions.

Unit I: Frequency distribution, measures of central tendency, Measures of Dispersion: Standard deviation, Quartile deviation, co-efficient of variation, Skewness and Kurtosis. Correlation and regression; Karl Pearson's co-efficient of correlation, Spearman Rank correlation co-efficient, regression lines and equations **(Contact Hours: 25)**

Unit II: Probability; Basic terminology, Mathematical definition of probability, statistical probability, axiomatic approach of probability. Addition theorem of probability, Conditional probability, independent events, multiplication theorem of probability. Baye's theorem. Theoretical Probability Distribution: Binomial, Poisson and Normal distribution. **(Contact Hours: 30)**

Books Recommended:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons (2020).

2. M. Spiegel , J. Schiller , R. A. Srinivasan and D. Goswami, *Probability and Statistics*, McGraw Hill education; 3rd edition (2017).

3. R. V. Hogg, J. W. McKean and A.T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, (2018).

COs- POs/PSOs Matrix of the Course

PSOs/POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO2	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
CO3	3	3	-	-	-	2	-	-	-	-	-	-	3	2	0	0	0
Average	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**0**	**0**	**0**

High-3, Medium-2, Low-1, No Correlation-0