LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (LOCF) FOR UNDERGRADUATE PROGRAMME

PG & RESEARCH DEPARTMENT OF MATHEMATICS

LOYOLA COLLEGE (AUTONOMOUS)
CHENNAI - 600034

PREFACE

Mathematics is the science of structures, order and relation that has evolved from elementary practices of counting, measuring and describing the shapes of objects, numbers, quantity, space and algebraic structures either as abstract concepts or applied in various disciplines. The under graduate programme is equipped with the wide range of branches in mathematics such as algebra, analytical geometry, trigonometry, calculus, vector analysis, differential equations, operations research, mathematical analysis, numerical methods using C and PYTHON.

The school of computational sciences aspires to equip students with a globally relevant curriculum and a scientific approach. Students are expected to develop a scientific temperament in the long run. Ultimately, in everyday life, this scientific temper applies a scientific technique of decision-making.

The curriculum designed by the department of mathematics seeks to offer students with disciplinary knowledge as well as digital literacy. This progressively improves the learners' ability to locate, assess and clearly explain information. It makes learners develop critical thinking skills. It also improves the spirit of collaboration and ethical standards. As a result, both on an individual and organizational level, this serves as a guide to behaviour.

The undergraduate mathematics programme, which includes a learning outcomes-based curriculum framework (LOCF), meets the demands of students in the field of mathematical sciences. This new structure is supposed to aid in the maintenance of the mathematics program's standard across the country. It also keeps the standard of quality up to date by examining and amending a broad framework of programme qualities, course descriptors, programme learning outcomes, and course outcomes.

At the undergraduate level, learners are expected to be taught mathematical concepts, methods, methodologies, models, structures and spaces using this innovative approach to curriculum planning. The first and second semester courses are designed to connect the mathematical ideas taught in the higher secondary school.

Overall, the training that students attain from all of the courses prepares them to utilize what they've learnt in pursuing higher education and future endeavours. Altogether, this provides learners with a variety of options to build skills for job advancement and research.

In a broader sense, this curriculum has been created to meet the needs of students by providing them with exposure to current trends in mathematical sciences. It helps students improve their critical thinking, analytical reasoning, and problem-solving abilities. LOCF also builds the personality of young brains as a holistic and socially responsible human being by improving scientific thinking, entrepreneurial abilities and human values.

CONTENTS

VISION AND MISSION OF LOYOLA COLLEGE, CHENNAI

VISION

- Towards holistic formation of youth, grounded in excellence, through accompaniment to serve the humanity.

MISSION

- To provide inclusive education through an integral and holistic formative pedagogy.
- To promote skills that prepares them for the future.
- To kindle in young minds, the spirit of social and environmental justice with a blend of academic excellence and empathy.
- To stimulate critical and conscientious scholarship leading to meaningful and innovative human capital.

CORE VALUES

- Cura Personalis
- Pursuit of Excellence
- Moral Rectitude
- Social Equity
- Fostering solidarity
- Global Vision
- Spiritual Quotient

VISION AND MISSION OF THE DEPARTMENT

VISION

- To acquaint coherent knowledge of mathematics to form credible, innovative and socially committed citizens.

MISSION

- To explore and elevate mathematical techniques and enable students with academic excellence and core competencies.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
(School of Computational Sciences)

PEO1	**LEARNING ENVIRONMENT AND LIFE LONG LEARNING** To access academic facilities in an environment of inclusiveness and inquisitiveness for effective and immersed learning throughout life to attain excellence in the chosen field of computational sciences.
PEO2	**GLOBALLY RELEVANT CURRICULUM AND SCIENTIFIC TEMPERAMENT** To think innovatively, analyse scientifically and make decisions appropriately, for handling contemporary global concerns through the knowledge earned in the computational sciences curriculum.
PEO3	**ACADEMIC EXCELLENCE AND CORE COMPETENCY** To excel in modern computational techniques and compete in higher studies/career, for addressing contemporary challenging problems with ease.
PEO4	**SKILL DEVELOPMENT AND ENTREPRENEURSHIP** To develop analytical, logical and critical problem-solving skills for executing professional work and become experts/entrepreneurs in the field of computational sciences.
PEO5	**ENVIRONMENT AND SUSTAINABILITY** To identify real world problems concerning environment and other issues; and apply the expertise in the computational sciences, to face the challenges and provide sustainable solutions.
PEO6	**PROFESSIONALISM AND ETHICS WITH SOCIAL RESPONSIBILITY** To equip themselves with the necessary competency towards professionalism in the computational sciences maintaining ethical standards in addressing the needs of industry and society.

PROGRAMME OUTCOMES (POs)
(School of Computational Sciences)

PO1	**DISCIPLINARY KNOWLEDGE & INFORMATION/DIGITAL LITERACY** To acquire literacy in the respective discipline of computational sciences and demonstrate scholarly knowledge in the information-digital era.
PO2	**SELF DIRECTED AND LIFE-LONG LEARNING** To adapt oneself to technological advancements in computing and engage in life-long self-learning for personal development in the context of interdisciplinary nature of future endeavours.
PO3	**SUSTAINABLE SOCIAL AND ENVIRONMENTAL CONSCIOUSNESS** To realize social and environmental problems and contribute the computational expertise to face the challenges and provide sustainable solutions.
PO4	**CRITICAL THINKING; ANALYTICAL REASONING & PROBLEM-SOLVING** To critically reason out, analyse and develop solutions through various computational techniques for real time problems.
PO5	**SCIENTIFIC REASONING AND COMMUNICATION SKILLS** To apply scientific reasoning in the approach to handle professional matters, communicate the solutions to stakeholders and enable them to understand and appreciate the outcomes.
PO6	**PROFESSIONALISM; TEAMWORK AND ETHICS** To manifest the core competencies, adhere to collaborative efforts within ethical frameworks and emerge as professionals holding key positions in the respective domains.
PO7	**SKILL DEVELOPMENT FOR LEADERSHIP AND ENTREPRENEURSHIP** To construct togetherness with people by building professional skills and provide effective leadership progressing to become experts/entrepreneurs in the field of computational sciences.

PROGRAMME SPECIFIC OUTCOMES (PSOs)
(PG & Research Department of Mathematics)

PSO1	To explain and appreciate mathematical concepts and its principles to identify, formulate and obtain solutions to real life problems.
PSO2	To demonstrate analytical skills to cater the needs of industrial problems.
PSO3	To acquaint core competencies of mathematics to emerge as professionals and successful entrepreneurs with ethical attitude and teamwork spirit.
PSO4	To think critically and offer logical solutions with benevolence in handling social related problems.
PSO5	To design mathematical models for a sustainable environment.
PSO6	To endure learning in order to maintain pace with advancement of mathematics.
PSO7	To appreciate different dimensions of contemporary mathematics and develop & integrate appropriate solutions to the problems faced by people in diverse domains.

B.Sc. MATHEMATICS RESTRUCTURED CBCS CURRICULUM WITH EFFECT FROM JUNE 2019

PART	SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV	SEMESTER V		SEMESTER VI	CREDITS
I	General Language (3h/3c)	General Language (3h/3c)	General Language (3h/3c)	General Language (3h/3c)				12
II	General English (6h/3c)	General English (6h/3c)	General English (5h/3c)	General English (5h/3c)				12
III MC	Algebra (6h/6c)	Analytical Geometry (6h/6c)	Abstract Algebra (6h/6c)	Real Analysis - I (6h/6c)	Real Analysis - II (6h/6c)		Complex Analysis (6h/6c)	84
	Calculus (6h/6c)	Trigonometry, Fourier series &Vector Analysis (6h/6c)	Differential Equations and Laplace Transform (6h/6c)		Linear Algebra (6h/6c)		Operations Research (6h/6c)	
					Discrete Mathematics (6h/6c)		Mechanics (6h/6c)	
					Mathematical Tools for Analytics (3h/3c)			
					Mathematical Tools for Analytics Lab (3h/3c)			
AR/AO	Physics for Mathematics (4h/2c)	Mathematical Statistics (6h/3c)	Basic Accounting (5h/3c) / PYTHON Programming (5h/3c)	Java Programming (5h/3c) / Applied Physics (3h/2c) / Applied Chemistry (3h/2c)				12`
	Physics for Mathematics Practical (2h/1c)			Applied Physics Lab (2h/1c) / Applied Chemistry Lab (2h/1c)				
ME				Combinatorics (6h/6c)	Graph Theory (6h/6c)			12
				Astronomy (6h/6c)	Fuzzy Sets and Applications (6h/6c)			
MS							Numerical Methods Using C (4h/3c)	15 (MS & TP)
							Mastering Mathematics using PYTHON (4h/3c)	
							Programming Numerical Methods using C & PYTHON Lab (4h/3c)	
BT/AT/NME					MOOC/SSP			
			Mathematics for Competitive Exams (3h/2c)	Popular Astronomy (3h/2c)				4
FC	FC (3h/1c)	FC (3h/2c)	FC (2h/1c)	FC (2h/1c)				5
CCA	CCA	CCA (90h/1c)						1
ORA			ORA	ORA (120h/2c)				2
Hr/C	**30h/22c**	**30h/(23+1)c**	**30h/24c**	**30h/(24+2)c**	**30h/30c**		**30h/33c**	**180h/159c**

Internship for 4 weeks during Christmas Holidays (30 Days)

B.Sc. MATHEMATICS OVERALL COURSE STRUCTURE
(2019 - Restructured Curriculum)

Sem	Course Code	Course Title	T/L/ TP	Category	Cr	Hrs
I	UTL 1101	General Tamil – I	T	GL	3	3
	UFR 1101	French for Beginners - I				
	UOL 1101	Hindi Prose - I				
	UOL 1104	General Sanskrit - I				
I	UEL 1201	General English I - Advanced	T	GE	3	6
	UEL 1202	General English I - Intermediate				
	UEL 1203	General English I - Basic				
I	UMT 1501	Algebra	T	MC	6	6
I	UMT 1502	Calculus	T	MC	6	6
I	UPH 1301	Physics for Mathematics	T	AR	2	4
I	UPH 1302	Physics for Mathematics Practicals	L	AR	1	2
I	UHE 1001	Personality Development	T	FC	1	3
II	UTL 2101	General Tamil - II	T	GL	3	3
	UFR 2101	French for Beginners - II				
	UOL 2101	Hindi Prose - II				
	UOL 2103	General Sanskrit - II				
II	UEL 2201	General English II - Advanced	T	GE	3	6
	UEL 2202	General English II - Intermediate				
	UEL 2203	General English II - Basic				
II	UMT 2501	Analytical Geometry	T	MC	6	6
II	UMT 2502	Trigonometry, Fourier series & Vector Analysis	T	MC	6	6
II	UST 2302	Mathematical Statistics	T	AR	3	6
II	UHE 2001	Life Issues and Coping Strategies	T	FC	2	3
III	UTL 3101	General Tamil - III	T	GL	3	3
	UFR 3101	French for Beginners - III				
	UOL 3101	Hindi Poetry - III				
	UOL 3102	General Sanskrit - III				
III	UEL 3201	General English III - Advanced	T	GE	3	5
	UEL 3202	General English III - Intermediate				
	UEL 3203	General English III - Basic				
III	UMT 3501	Abstract Algebra	T	MC	6	6
III	UMT 3502	Differential Equations and Laplace Transform	T	MC	6	6
III	UCO 3402	Basic Accounting	T	AO	3	5
	UST 3401	PYTHON Programming				
III	UHE 3001	Social Awareness	T	FC	1	2

III	UAZ 3801	Conservation Biology	T	NME	2	3
	UBC 3801	Entrepreneurship	T			
	UBU 3801	Business Leadership	T			
	UCA 3801	Animation	L			
	UCH 3801	Chemistry in Everyday Life	T			
	UCS 3801	Introduction to Data Analytics	L			
	UEC 3801	Green Economics	T			
	UEL 3801	Popular Writing for Media	T			
	UFR 3801	Spoken French	L			
	UFR 3802	Elementary French - I	T			
	UHT 3801	History of Architecture in India	T			
	UMM 3801	Visualization for Animation	T			
	UOL 3801	Hindi for Beginners - I	T			
	UOL 3802	Hindi for Communication - I	T			
	UOL 3803	Sanskrit through Stories - I	T			
	UPB 3801	Herbal Medicines	T			
	UPH 3801	Workshop Practice and Wiring	T			
	USO 3801	Gender and Society	T			
	USO 3802	Sociology of Crime and Deviance	T			
	UST 3801	Basic Statistics	T			
	UTL 3801	Basic Tamil - I	T			
	UTL 3802	Advanced Tamil - I	T			
	UVC 3801	Basic Photography	L			
IV	UTL 4102	General Tamil - IV	T	GL	3	3
	UFR 4101	French for Beginners - IV				
	UOL 4101	Hindi Poetry - IV				
	UOL 4102	General Sanskrit - IV				
IV	UEL 4201	Introduction to Technical Translation	T	GE	3	5
	UEL 4202	Soft skills for Professional Development				
	UEL 4203	Professional Content Writing				
	UEL 4204	English for Technical Writing				
	UEL 4205	English for Employability Skills				
	UEL 4206	Essential Skills for Group Communication				
	UEL 4207	Theatre Performance and Film Review				
IV	UMT 4501	Real Analysis - I	T	MC	6	6
IV	UMT 4601	Combinatorics	T	ME	6	6
IV	UMT 4602	Astronomy	T			
IV	UCS 4401	JAVA Programming	T	AO	3	5
	UCH 4401	Applied Chemistry for Mathematics	T		2	3

	UCH 4402	Applied Chemistry Practical for Mathematics	L		1	2
	UPH 4401	Applied Physics	T		2	3
	UPH 4402	Applied Physics Lab	L		1	2
IV	UHE 4001	Environmental Studies	T	FC	1	2
IV	UAZ 4801	Green Technologies	T	NME	2	3
	UBC 4801	Fundamentals of Investment	T			
	UBU 4801	Business Models	T			
	UCA 4801	Web Design	T			
	UCH 4801	Basic Clinical and Pharmaceutical Chemistry	T			
	UEC 4801	Entrepreneurial Economics	T			
	UEL 4801	Award Winning Fiction	T			
	UEL 4802	Popular Writing for Media	T			
	UFR 4801	Spoken French - II	T			
	UHT 4801	Cultural Diversity of India	T			
	UMM 4801	Media Studies	T			
	UOL 4801	Hindi for Beginners - II	T			
	UOL 4802	Hindi For Communication - II	T			
	UPB 4801	Mushroom Cultivation	T			
	UPH 4801	Electronic Gadgets	T			
	USO 4801	Families and Intimate Relationship	T			
	USO 4802	People, Power and Politics	T			
	UST 4801	Data Analysis using SPSS	T			
	UTL 4801	Basic Tamil - II	T			
	UTL 4802	Advanced Tamil - II	T			
	UVC 4801	Design Basics	T			
IV	-	Community Services	-	ORA	2	-
V	UMT 5501	Real Analysis - II	T	MC	6	6
V	UMT 5502	Linear Algebra	T	MC	6	6
V	UMT 5503	Discrete Mathematics	T	MC	6	6
V	UMT 5504	Mathematical Tools for Analytics	T	MC	3	3
V	UMT 5505	Mathematical Tools for Analytics Lab	L	MC	3	3
V	UMT 5601	Graph Theory	T	ME	6	6
V	UMT 5602	Fuzzy Sets and Applications	T			
VI	UMT 6501	Complex Analysis	T	MC	6	6
VI	UMT 6502	Operations Research	T	MC	6	6
VI	UMT 6503	Mechanics	T	MC	6	6
VI	UMT 6701	Numerical Methods Using C	T	MS	3	4
VI	UMT 6702	Mastering Mathematics using PYTHON	T		3	4

VI	UMT 6706	Programming Numerical Methods using C & PYTHON Lab	L		3	4
VI	UMT 6705	Internship	TP		6	-

COURSES OFFERED TO OTHER DEPARTMENTS

Sem	Course Code	Course Title	T/L	Category	Cr	Hrs
I	UMT 1301	Mathematics for Physics - I	T	AR	3	6
I	UMT 1302	Mathematics for Chemistry - I	T	AR	3	6
I	UMT 1303	Mathematics for Statistics - I	T	AR	3	6
III	UMT 3401	Mathematics for Chemistry - II	T	AO	3	5
III	UMT 3801	Mathematics for Competitive Examinations	T	NME	2	3
IV	UMT 4401	Mathematics for Commerce	T	AO	3	5
IV	UMT 4402	Mathematics for Physics - II	T	AO	3	5
IV	UMT 4403	Mathematics for Statistics - II	T	AO	3	5
IV	UMT 4404	Advanced Mathematics for Economics	T	AO	3	5
IV	UMT 4405	Mathematics for Computer Applications	T	AO	3	5
IV	UMT 4406	Mathematics for Computer Science	T	AO	3	5
IV	UMT 4801	Popular Astronomy	T	NME	2	3

COURSE DESCRIPTORS

(Offered by the Department)

Course Code	UMT 1501
Course Title	Algebra
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	I
Regulation	2019

Course Overview

1. Algebra is one broad area of mathematics which is a unifying thread of almost all branches of mathematics. In general, it is the study of mathematical symbols and the rules for manipulating those symbols.
2. This course deals with solving equations of various degrees using multiple methodologies.
3. In this course, the nature of infinite series is identified and summation techniques are inculcated.
4. This course also deals about significant properties of square matrices and diagonalization.
5. Another significant area of mathematics called number theory is been introduced in this course.

Course Objectives

1. To understand the relation between the roots and the coefficients of polynomial equations so as to deduce r^{th} powers of roots.
2. To learn different techniques and methodologies to find solution of polynomials.
3. To classify and estimate various types of infinite series.
4. To summarize the significance of eigen values and eigen vectors in diagonalizing matrices.
5. To apply the concept of congruence to derive fundamental standard theorems in number theory.

Prerequisites	Fundamental knowledge on number system, arithmetic and matrices.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Theory of equations - Irrational roots and Imaginary roots - Relation between roots and coefficients - Sum of the r^{th} powers of roots - Reciprocal equations.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Transformations - Descartes' rule of signs - Approximate solutions of polynomial by Horner's method-Cardon's method of solution of a cubic polynomial.	15	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Partial fractions - Binomial, Exponential and Logarithmic series (without proofs) - Application to summation of series.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Eigen values and Eigen vectors - Cayley Hamilton theorem - Diagonalization of matrices.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Theory of numbers - Euler's function $\phi(N)$ - The highest power of a prime p contained in n! - Congruences - Fermat's theorem - Wilson's theorem.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Algebra Volume I, T.K. Manicavachagom Pillay, T. Natarajan, K.S. Ganapathy, S. Viswanathan Printers and Publishers, 1996.
   Unit 1: Chapter 6 - Sections: 1-11, 13, 14, 16, 17, 19
   Unit 2: Chapter 6 - Sections: 21, 24, 30, 34.1 (i)
   Unit 3: Chapter 1 - Section: 3, Chapter 3 - Sections: 1, 10, Chapter 4 - Sections: 2, 3, 5-9
2. Algebra Volume II, T. K. Manicavachagom Pillay, T. Natarajan, K. S. Ganapathy, S. Viswanathan Printers and Publishers, 1996.
   Unit 4: Chapter 2 - Sections: 16, 16.1-16.5
   Unit 5: Chapter 5 - Sections: 1-10, 12-16, 17

Suggested Readings

1. Theory of Equations, Theory of Numbers and Trigonometry, Arumugam & Isaac, New Gamma Publishing House, 2011.
2. Algebra, Larry C. Grove & S. Kumaresan - Dover Publications - 2012.
3. Algebra and Trigonometry, Volume I & II, P. R. Vittal & V. Malini, Margham Publishers.
4. A Text Book of Matrices, Harikishan, Atlantic Publishers and Distributors, 2008.
5. Elementary Number Theory, David M. Burton, McGraw Hill Publication, 7th Edition, 2017.

Web Resources

1. www.mathworld.wolfram.com
2. https://mathsolver.microsoft.com
3. https://themathpage.com

4. www.numbertheory.org

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

Cos	CO Description	Cognitive Level
CO1	To grasp the fundamental notions of number theory, various series and to find the roots of equations.	K1, K2
CO2	To apply the acquired knowledge from the known results in solving algebraic problems.	K3
CO3	To analyze the concept of reciprocal equations, series categorization and congruence relations.	K4
CO4	To evaluate the eigen vectors, to estimate the sum of infinite series and to examine the occurrence and approximation of roots.	K5
CO5	To construct cubic equations in solving polynomials and to form similar matrices in diagonalization process.	K6

Course Code	UMT 1502
Course Title	Calculus
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	I
Regulation	2019

Course Overview

1. This course aims to provide the fundamental knowledge and applications of differential and integral calculus.
2. Methods to find the extreme values of differentiable functions and geometrical applications of derivatives are discussed.
3. The concept of integration, its properties and various techniques of evaluation of integrals are studied.
4. Double and triple integrals are introduced and the techniques of change of order and change of variables are discussed to evaluate the integrals.
5. Beta and gamma functions are defined and utilized in the evaluation of suitable integrals.

Course Objectives

1. To understand the implications of higher derivatives and find the extreme values of differentiable functions.
2. To interpret the concept of derivatives and their applications geometrically.
3. To know the standard methods of evaluation of integrals.
4. To evaluate double and triple integrals.
5. To utilize beta and gamma functions in evaluating certain integrals.

Prerequisites	Basic knowledge in differentiation and integration.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Leibnitz theorem and its applications - Maxima and minima of functions of two variables - Lagrange's Method of Undetermined Multipliers (without proof).	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Subtangents and Subnormals in Cartesian and Polar Coordinates - Slope of a Curve and Angle of Intersection of Curves in Polar	15	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

	Coordinates, Curvature - Radius of Curvature in Cartesian Coordinates, Centre of Curvature, Evolutes.		CO4 CO5	
III	Methods of integration - Definite integrals - Properties of definite integrals - Integration by parts - Reduction formulae.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Double and Triple integrals - Change of order of integration - Change of variables - Jacobian	17	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Beta and Gamma Integrals and their properties - Relation between beta and gamma functions.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Calculus Volume II, S. Narayanan, T. K. Manicavachagom Pillay, S. Viswanathan Printers and Publishers, 2007.
   Unit 1: Chapter 3 - Sections: 2.1, 2.2, Chapter 8 - Sections: 4, 5
   Unit 2: Chapter 9 - Sections: 2, 3, 4.1-4.5, Chapter 10 - Sections: 2.1-2.6
2. Calculus Volume II, S. Narayanan, T. K. Manicavachagom Pillay, S. Viswanathan Printers and Publishers, 2012.
   Unit 3: Chapter 1 - Sections: 5, 6.1-6.6, 7.1-7.5, 8 Cases (i) to (iv), 11, 12, 13
   Unit 4: Chapter 5 - Sections: 1, 2.1-2.2, 4, Chapter 6 - Sections: 1.1, 1.2, 2.1
   Unit 5: Chapter 7 - Sections: 2.1-2.3, 3, 4, 5

Suggested Readings

1. Differential Calculus, Shanti Narayan, S., Chand & Co., 10th Edition Reprint, 2001.
2. Integral Calculus, Shanti Narayan, Dr. P. K. Mittal, S., Chand & Co., 11th Edition Reprint, 2018.

Web Resources

1. https://bit.ly/3FGGW2H
2. https://nitkkr.ac.in/docs/2-Geometrical%20Applications%20of%20Differentiation.pdf
3. https://mast.queensu.ca/~math121/Notes/notes09.pdf
4. https://ocw.mit.edu/ans7870/textbooks/Strang/Edited/Calculus/14.pdf
5. https://www.mit.edu/~jeffery/gamma_beta.pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To define and understand the basic concepts of differential and integral calculus.	K1, K2
CO2	To employ various techniques in finding derivatives and evaluating multiple integrals.	K3
CO3	To analyze and explain the results of calculus through illustrations with examples.	K4
CO4	To predict appropriate methods to find the solution of problems on differential and integral calculus.	K5
CO5	To generate more ideas of calculus in various streams of science and technology.	K6

Course Code	UMT 2501
Course Title	Analytical Geometry
Credits	6
Hours/Week	6
Category	MC
Semester	II
Regulation	2019

Course Overview

1. Analytical Geometry connects algebraic equations and geometric curves.
2. The main aim is to study a few structures on two and three-dimensional geometry.
3. It deals on tracing a conic with in-depth characterization.
4. This enables us to examine the theoretical knowledge of various three-dimensional structures.
5. The course is structured in applying the principles and methods of analytical geometry to the straight line, circle, parabola, sphere, etc.

Course Objectives

1. To understand the concept of pole and polar, chord, tangent and conjugate diameters in conics.
2. To study the concepts of asymptotes of hyperbola.
3. To apply the knowledge of direction cosines and direction ratios in straight lines and planes.
4. To visualize spheres and to develop tangent plane of a sphere.
5. To construct cone and cylinder using a generator.

Prerequisites	Basic knowledge of Analytical Geometry

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Conics - pole and polar - chord in terms of midpoint - pair of tangents - conjugate diameters for ellipse.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Asymptotes of hyperbola - rectangular hyperbola - polar equations of a line, circle and conic.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	3D Geometry: Direction cosines and direction ratios - Planes - Straight lines - the plane and the straight lines - Coplanar lines.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Spheres: Definition - Equation of sphere - Equation of circle on a sphere - Equation of the tangent plane to the sphere.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Equation of a surface - Cone - Right circular cone - cylinder - Right circular cylinder - enveloping cylinder.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. A text book of Analytical Geometry (Part I - Two Dimensions), T. K. Manicavachagom Pillay, T. Natarajan, S. Viswanathan Printers and Publishers, 1996.
   Unit 1: Chapter 6 - Sections: 6.1, 6.6, 6.7, 6.13, 6.16-6.16.4
   Unit 2: Chapter 8 - Sections: 8.8, 8.10-8.10.2, Chapter 9 - Sections: 9.1-9.9.1
2. A text book of Analytical Geometry (Part II - Three Dimensions), T.K. Manicavachagom Pillay, T. Natarajan, S. Viswanathan Printers and Publishers, 2015.
   Unit 3: Chapter 1 - Sections: 1.1-1.5, 1.7-1.8, 1.10-1.12, Chapter 2 - Sections: 2.1-2.11
   Chapter 3 - Sections: 3.1-3.8
   Unit 4: Chapter 4 - Sections: 4.1-4.8
   Unit 5: Chapter 5 - Sections: 5.1-5.2.1, 5.8-5.9.3

Suggested Readings

1. Coordinate Geometry, Duraipandian. P, Emerald Publishers, 1984.
2. Engineering Mathematics Volume I, Arumugam S, Isaac A, Scitech Publications, 1999.
3. Coordinate Geometry, Duraipandian. P, Emerald Publishers, 1984.

Web Resources

1. https://slideplayer.com/slide/10560643/
2. https://www.toppr.com/guides/maths/three-dimensional-geometry/
3. https://archive.org/details/in.ernet.dli.2015.148219/page/n9/mode/2up
4. https://fdocuments.in/document/a-textbook-of-analytical-geometry-of-two dimensions.html

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

Cos	CO Description	Cognitive Level
CO1	To understand and recognize different geometrical structures and related theory using abstract skills	K1, K2
CO2	To determine the geometrical aspects of two and three-dimensional structures.	K3
CO3	To identify certain concepts in ellipse, hyperbola, planes, sphere, cone and cylinder and to solve problems using them.	K4
CO4	To visualize and examine two dimensional shapes on three-dimensional structure and its characteristics.	K5
CO5	To derive asymptotes, conical structures and solve related problems.	K6

Course Code	UMT 2502
Course Title	Trigonometry, Fourier Series and Vector Analysis
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	II
Regulation	2019

Course Overview

1. This course widely covers the fundamental principles of Trigonometry, Fourier series, Vector Analysis and their applications.
2. Various trigonometric functions and their relationships are clearly explored.
3. Fourier series expansions of even, odd and periodic functions are examined systematically.
4. The different aspects of vector differentiation and its applications to geometry are discussed.
5. Vector integration problem and its applications are evaluated elaborately.

Course Objectives

1. To understand the relationship between hyperbolic and trigonometric functions.
2. To expand a trigonometric function as a series function.
3. To determine the Fourier series expansions of certain functions and investigate its convergence.
4. To assimilate the concept of vector differential operators and solve related problems.
5. To grasp the theory of vector calculus for evaluating line, surface and volume integrals.

Prerequisites	Basic knowledge of trigonometry, differentiation and integration.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Expansions of $\cos n\theta$, $\sin n\theta$ and $\tan n\theta$ and powers of sines and cosines of θ in terms of functions of multiples of θ - Expansion of $\sin\theta$ and $\cos\theta$ in a series of ascending powers of θ.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Hyperbolic functions - Relation between hyperbolic and circular functions - Inverse Hyperbolic Functions - Logarithms of a complex number.	15	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Periodic function - Even and Odd function - Dirichlet's conditions - Convergence of Fourier series - Half range Fourier series.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Vector differentiation - Directional derivative - Unit normal to the surface - Equation of tangent plane to a surface - Equation of normal to a surface - Divergence - Curl - Laplace operators.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Evaluation of Line integral, Surface integral and Volume integral - Verification of Green's theorem, Gauss-Divergence theorem, Strokes theorem (proofs of theorems not included), Simple problems.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Trigonometry, Narayanan S. and Manicavachagom Pillay T. K., Ananda Book Depot, 2017.
   Unit 1: Chapter 3 - Section: 1 - 5
   Unit 2: Chapter 4 - Section: 1 - 2, Chapter 5 - Section: 5
2. Calculus Vol. III, Narayanan S. and Manicavachagom Pillay T. K., Ananda Book Depot, 2018.
   Unit 3: Chapter 6 - Sections: 1 - 5
3. Analytical Geometry 3D and Vector Calculus, Arumugam S. and Thangapandi Isaac A, New Gamma Publishing House, 2017.
   Unit 4: Chapter 5 - Sections: 5.2 - 5.4
   Unit 5: Chapter 7 - Sections: 7.1 - 7.3

Suggested Readings

1. Trigonometry, Vittal P. R., Margham Publications, 1988.
2. Engineering Mathematics Vol I, Arumugam S, and Isaac A, Scitech Publications, 1999.
3. Vector Analysis, Murray R. Spiegel, McGraw Hill, Second Edition, 2017.
4. A Textbook of Advance Calculus Vectors and Numerical Analysis, Ansari. B, Manglam Publications, First Edition, 2007.
5. Fourier Series, Fourier Transform and their applications to Mathematical Physics, Valery Serov, Springer, Kindle Edition, 2018.
6. Vector Analysis, Duraipandian P and Laxmi Duraipandian, Emerald Publishers, Second Edition, 2003.

Web Resources

1. https://brilliant.org/wiki/expansions-of-certain-trigonometric-functions/

2. https://www.mathsisfun.com/sets/function-hyperbolic.html
3. https://www.youtube.com/watch?v=Wfpb-fniSSk
4. https://www.youtube.com/watch?v=spUNpyF58BY&t=51s
5. https://www.whitman.edu/mathematics/calculus_online/chapter16.html

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To recall and recognize trigonometric functions, vector calculus and Fourier series.	K1, K2
CO2	To develop the expansions of basic trigonometric, hyperbolic functions, Fourier series and to perform vector differential operations.	K3
CO3	To examine the series expansion of inverse trigonometric functions and hyperbolic functions, vector differentiation and integration.	K4
CO4	To interpret the relation between the hyperbolic trigonometric functions and circular functions and to evaluate Fourier series, surface and volume integrals.	K5
CO5	To facilitate Fourier series expansion of certain functions and the significance of integral theorems.	K6

Course Code	UMT 3501
Course Title	Abstract Algebra
Credits	6
Hours/Week	6
Category	Major Core (MC) – Theory
Semester	III
Regulation	2019

Course Overview

1. Abstract algebra is a broad field of mathematics, concerned with algebraic structures which include groups, rings and fields.
2. This course deals with the concepts of sets, integers and basic algebraic structures.
3. A detailed study on basic algebraic structures is dealt in this course.
4. It helps to know the notion of proofs and importance of theorems.
5. It deals with a few applications of abstract algebra in the field of cryptography.

Course Objectives

1. To introduce the basic algebraic structures and understand their development.
2. To understand the theory of algebraic structures and exercise solving of problems related to them.
3. To explore the algebraic structures in various fields.
4. To analyze different algebraic structures and their theories.
5. To familiarize the importance of Abstract Algebra in applied mathematics and Cryptography.

Pre-requisites	Basic knowledge in theory of sets and numbers.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Set Theory - The integers - Definition of a group - Some Examples of a Group - Some Preliminary Lemmas	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Subgroups - A counting principle - Normal Subgroups and Quotient Groups.	16	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Homomorphism - Automorphisms - Cayley's Theorem - Permutation Groups (Definitions and Example only).	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Ring Theory - Definition and Examples of Rings - Some Special Classes of Rings - Homomorphisms (Definitions and Example only) - Ideals and Quotient Rings.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	More Ideals and Quotient Rings - Euclidean Rings. Introduction to Cryptography: Private Key Cryptography.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. I. N. Herstein, Topics in Algebra, Wiley India (P) Ltd., New Delhi, Second Edition, 2014.
   Unit 1: Chapters 1 and 2 - Sections: 1.1, 1.3, 2.1 - 2.3.
   Unit 2: Chapter 2 - Sections: 2.4 - 2. 6.
   Unit 3: Chapter 2 - Section: 2.7, (Exclude Application 1, 2 and Corollary),
   Section: 2.8 (Exclude Lemma 2.8.2, 2.8.3, Example 2.8.1, 2.8.2),
   Section: 2.9 (Exclude Theorem 2.9.2 and Lemma 2.9.1, Applications),
   Section: 2.10 (Definitions and Examples only)
   Unit 4: Chapter 3 - Sections: 3.1 - 3.4
   Unit 5: Chapter 3 - Sections 3.5, 3.7
2. Thomas W. Judson, Abstract Algebra Theory and Applications, Orthogonal Publishing, L3c, 2013
   Unit 5: Chapter 7 - Sections: 7.1, 7.2

Suggested Readings

1. Charles C. Pinter, A book of Abstract Algebra, Dover Publications, Second Edition.
2. John B. Fraleigh, A First Course in Abstract Algebra, Pearson Education India, Seventh Edition.
3. Vijay K Khanna, S K Bhambri, A Course in Abstract Algebra, Vikas Publishing, 2017.
4. Santiago M. L, Modern Algebra, Tata McGraw - Hill, Second Edition, 2001.
5. Arumugam S., Isaac A. T, Modern Algebra, SciTech publications (India) Pvt. Ltd, 2015.

Web Resources

1. https://ocw.mit.edu/courses/mathematics/18-703-modern-algebra-spring-2013/
2. http://www.math.clemson.edu/~macaule/classes/m20_math4120/

3. https://www.khanacademy.org/math
4. https://www.mathway.com/Algebra
5. https://ocw.mit.edu/courses/mathematics/18-703-modern-algebra-spring-2013/

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the concepts in theory of sets, Groups, Rings and cryptosystems.	K1, K2
CO2	To apply the theory of abstract algebra in solving related problems	K3
CO3	To analyze the concepts of abstract algebra and homomorphisms and isomorphisms between the algebraic structures	K4
CO4	To compare different algebraic structures and their theories	K5
CO5	To create and apply the concept of algebraic structures in the field of cryptography.	K6

Course Code	UMT 3502
Course Title	Differential Equations and Laplace Transform
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	III
Regulation	2019

Course Overview

1. This course extensively deals with differential equations and suitable methods to solve them.
2. First order ordinary differential equation and its applications are discussed.
3. Linear differential equations with constant and variable coefficients along with some applications are studied.
4. Various methods to solve partial differential equations are explored.
5. Laplace transforms, inverse Laplace transforms and their properties are examined.

Course Objectives

1. To recognize and implement solution techniques to solve first order differential equations concisely.
2. To solve second order linear differential equations with constant and variable coefficients using various methods.
3. To model and solve real-world phenomena using differential equations.
4. To classify partial differential equations and obtain their solutions systematically.
5. To utilize Laplace transformations for solving differential equations.

Prerequisites	Basic knowledge of differentiation, integration and theory of equations.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Ordinary Differential Equations: Solutions of first order and first-degree equations - Bernoulli's equation - Equations of first order but of higher degree - Clairaut's equation - Applications of Differential Equations of First Order: Physical applications - Simple electric circuits.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Linear Differential equations: Linear Differential equations with constant coefficients - Linear equations with variable coefficients (Cauchy-Euler equation) - Equations reducible to the linear	16	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

	homogeneous equation (Legendre linear equations) - Variation of parameters - Applications of Linear Differential Equations - Oscillatory electrical circuit - Deflections of beams.		CO4 CO5	
III	Partial Differential Equations: Formation of PDE - Complete integrals - Particular integrals-Singular integrals- Equations solving by direct integration - The four standard types - Lagrange's equation - Charpit's method.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Laplace transforms: Laplace Transform of standard functions and periodic functions - Some general Theorems - Initial and Final value theorems.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Inverse transform Applications of Laplace transform to solve ordinary differential equations with constant coefficient and system of differential equations - Unit step function - Transform of unit function.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Calculus, Volume III, by S. Narayanan, T. K. Manicavachagom Pillay, S. Viswanathan Printers and Publishers Pvt. Ltd., 2014

Unit 1: Chapter 1 - Section 2: 2.1 - 2.5, Section 5: 5.1 - 5.4, Section 5: 6.1 - 6.2
Unit 2: Chapter 2 - Section 1, 2, 3, 4, 8, 9, 10
Unit 3: Chapter 4 - Section 2: 2.1 - 2.2, Section:3, 4, Section 5: 5.1 - 5.4, Section 6, 7.
Unit 4: Chapter 5 - Sections: 1, 2, 3, 4, 5.
Unit 5: Chapter 5 - Sections: 6, 7, 8, 9.

2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publications, 2012.

Unit 1: Chapter 12 - Section 12: 12.4, 12.5.
Unit 2: Chapter 14 - Section 14: 14.5, 14.7.
Unit 5: Chapter 21 - Section 21: 21.17.1, 21.17.2.

Suggested Readings

1. Differential equations with Applications and Historical Notes, George F. Simmons, McGraw Publications, 2nd Edition, 2017.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India Pvt. Ltd., 9th Edition, 2011.
3. Elementary Differential Equations and Boundary Value Problems, William E. Boyce, RichardC. Di Prima, Douglas B. Meade, John Wiley & Sons Inc., 11th edition, 2017.
4. A First Course in Differential Equation with Applications, Macmillan Publications, 2006.
5. Ordinary and Partial Differential Equations, M.D. Raisinghania, S Chand & Co Ltd., 2017.

6. Differential Equations (Schaum's Outlines), Richard Bronson, Gabriel B. Costa, McGraw- Hill Education, 4th Edition, 2014.

Web Resources

1. https://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011
2. https://www.khanacademy.org/math
3. https://www.coursera.org/learn/differential-equations-engineers?#reviews

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the concepts of differential equations and Laplace transforms.	K1, K2
CO2	To determine the solutions of differential equations by various methods and Laplace transforms.	K3
CO3	To analyze the properties of Laplace transform and examine the solutions of ordinary and partial differential equations.	K4
CO4	To evaluate general solutions of ordinary and partial differential equations using various methods.	K5
CO5	To propose the solution of real-life problems using ordinary and partial differential equations.	K6

Course Code	UMT 4501
Course Title	Real Analysis - I
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	IV
Regulation	2019

Course Overview

1. This course deals with the real number system, sequences and infinite series on real numbers.
2. The concepts of sets and functions are analyzed.
3. The algebraic, order and completeness properties of the set of real numbers are discussed.
4. The notion of limits of sequences and related theorems are studied.
5. The behaviour of an infinite series is analyzed.

Course Objectives

1. To understand the fundamentals of sets and functions on real numbers.
2. To comprehend the algebraic, order and completeness properties of the set of real numbers.
3. To visualize the construction of the real line and its properties.
4. To realize the concepts of sequences and series and their applications in various fields of sciences.
5. To upgrade knowledge on higher dimensional Euclidean spaces.

Prerequisites	Basic knowledge in number system and set theory.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Sets and elements - Set operations - Functions - Direct and inverse images - Special types of functions - Inverse functions - Composition of functions - Restrictions of functions - Mathematical induction - Finite and infinite sets - Countable sets - Cantor's theorem.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Algebraic properties of R - Rational and irrational numbers - The order properties of R - Inequalities - Absolute value of a real number - Triangle inequality.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	The real line - Suprema and infima - The completeness property of R - Applications of the supremum property - Functions - Archimedean property - Density of rational numbers in R - Intervals - Characterization of intervals - Nested intervals - The uncountability of R.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Sequences and their limits - The limit of a sequence - Uniqueness of limits - Limit theorems - Squeeze theorem - Monotone sequences - Monotone convergence theorem - Euler's number - Subsequences and Bolzano Weierstrass theorem - Divergence criteria - The Cauchy criterion - Cauchy convergence theorem.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Introduction to infinite series - The nth term test - Cauchy criterion for series - Comparison test - Limit comparison test - Absolute convergence - Tests for absolute convergence - The root and ratio tests (statements only) - Integral test (statement only) -Raabe's test (statement only) - Tests for non-absolute convergence - Alternating series - Alternating series test - The Dirichlet and Abel tests (statements only) - Problems.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

Introduction to Real Analysis - Robert G. Bartle, and Donald R. Sherbert, John-Wiley & sons, Inc., 2011, Fourth Edition.

Unit 1: Chapter 1 - Sections 1.1: 1.1.1 - 1.1.14, 1.2: 1.2.1 - 1.2.4, 1.3: 1.3.1 - 1.3.13

Unit 2: Chapter 2 - Sections 2.1: 2.1.1 - 2.1.13, 2.2: 2.2.1 - 2.2.6

Unit 3: Chapter 2 - Sections 2.2: 2.2.7 - 2.2.9, 2.3: 2.3.1 - 2.3.6, 2.4: 2.4.1 - 2.4.6, 2.4.8 - 2.4.9
Section 2.5: 2.5.1 - 2.5.5

Unit 4: Chapter 3 - Sections 3.1: 3.1.1 - 3.1.11, 3.2: 3.2.1 - 3.2.11, 3.3: 3.3.1 - 3.3.6
Sections 3.4: 3.4.1 - 3.4.9, 3.5: 3.5.1 - 3.5.6

Unit 5: Chapter 3 - Sections 3.7: 3.7.1 - 3.7.9
Chapter 9 - Sections 9.1: 9.1.1 - 9.1.2, 9.2: 9.2.1 - 9.2.10, 9.3: 9.3.1 - 9.3.5

Suggested Readings

1. Topology of metric spaces, S. Kumaresan, Alpha Science International Ltd., 2005, First edition.
2. Real Analysis - K. Viswanatha Naik - Emerald Publishers - First Edition.
3. Introduction to Real Analysis, Liviu I. Nicolaescu University of Notre Dame, e book, 2021.
4. Methods of Real Analysis - Richard R Goldberg - Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi - 1970.

Web Resources

1. https://www.cimt.org.uk/projects/mepres/alevel/pure_ch13.pdf
2. https://www.youtube.com/watch?v=j9UczXkGj_c
3. https://www3.nd.edu/~lnicolae/Hon_Calc_Lectures.pdf
4. https://people.math.osu.edu/fowler.291/sequences-and-series.pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand various concepts related to the real number system.	K1, K2
CO2	To apply related theorems and techniques to solve problems on real numbers, sequences and series.	K3
CO3	To analyze the structure and properties of the real numbers, sequences and series.	K4
CO4	To justify the concepts of real line, sequences and series.	K5
CO5	To generate ideas and techniques in multidiscipline by utilizing the theory of real numbers.	K6

Course Code	UMT 4601
Course Title	Combinatorics
Credits	6
Hours/Week	6
Category	Major Elective (ME) - Theory
Semester	IV
Regulation	2019

Course Overview

1. Combinatorics is a field of mathematics concerned with problem of selection, arrangement and operation within a finite or discrete system.
2. It is applied in different areas such as communication networks, cryptography, network security, computational molecular biology, etc.
3. This course deals with the study of arrangement and counting of objects with certain properties.
4. It helps to understand the notion of generating functions to solve counting problems.
5. A detailed study of recurrence, derangement and inclusion-exclusion principle is carried out.

Course Objectives

1. To understand the basic concepts of combinatorics.
2. To use permutation and combination to solve counting problems.
3. To set up and utilize recurrence relations in solving combinatorial problems.
4. To analyze the concept of inclusion and exclusion principle.
5. To apply the ideas of permutation and combination to daily life situations of arranging and grouping the objects.

Prerequisites	Basic knowledge in set theory and numbers.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Introduction to basic ideas-general formula for f (n, k)-Recurrence relation-boundary condition-Fibonacci sequence-generating function.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Permutation-ordered selection-unordered selection-further remarks on Binomial theorem.	16	CO1 CO2	K1, K2, K3, K4, K5, K6

			CO3 CO4 CO5	
III	Passing within a set-Pairing between set and optimal assignment problem-Gala's optimal assignment problem	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Fibonacci type relation-using generating function-miscellaneous method.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	The inclusion-Exclusion Principle-Rook polynomial.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

A First course in combinatorial mathematics, Ian Anderson, Clarendon Press-Oxford, 1989, Second edition.

Unit 1: Chapter 1 - Section: 1
Unit 2: Chapter 2 - Sections: 2.1 - 2.5
Unit 3: Chapter 3 - Sections: 3.1 - 3.4
Unit 4: Chapter 4 - Sections: 4.1 - 4.3
Unit 5: Chapter 5 - Sections: 5.1 - 5.2.

Suggested Readings

1. Combinatorics, V.K. Balakrishnan, Schuam Series, 1996.
2. Combinatorics , George Duckett, Questions and Answers , 2015, e-Book.
3. A course in Combinatorics, Lint, J.H. Van and Wilson, R.M, Cambridge University Press, Reprinted 2007, Second Edition.
4. Combinatorics Problems and Solutions, Stefan Hollos and J. Richard Hollos, Abrazol Publishing, 2013, e-Book.

Web Resources

1. https://ocw.mit.edu/high-school/mathematics/combinatorics-the-fine-art-of-counting/related-resources.
2. https://www.coursera.org/courses?query=combinatorics

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the concepts of permutation, combination, recurrence relation, derangement and inclusion-exclusion principle.	K1, K2
CO2	To apply the concepts of permutation, combination, recurrence relation, derangement and inclusion-exclusion principle and determine the solutions of combinatorial problems.	K3
CO3	To analyze the concepts of permutation, combination, recurrence relation, derangement and inclusion-exclusion principle.	K4
CO4	To evaluate and interpret the solutions of some practical real-life problems.	K5
CO5	To facilitate the solutions of problems by various combinatorial methods.	K6

Course Code	UMT 4602
Course Title	Astronomy
Credits	6
Hours/Week	6
Category	Major Elective (ME) - Theory
Semester	IV
Regulation	2019

Course Overview

1. The course aims at exploring space science of celestial bodies.
2. It helps to acquire knowledge on motion of sun, moon, earth and stars.
3. Preview on astronomical events like eclipses and conjunctions is focused.
4. An insight into the origin of the universe and formation of galaxies is provided.
5. Handling of telescope is demonstrated.

Course Objectives

1. To understand astronomical phenomena of celestial bodies.
2. To visualize and analyze the occurrence of astronomical events.
3. To conceptualize the formation of the universe.
4. To catalog star categories.
5. To demonstrate star mapping and acquire knowledge about telescope.

Prerequisites	Basic knowledge in space science.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Introduction to Astronomy: Basic concepts and definitions- Equinox and Solstice- Coordinate systems-duration of day and night- Dip of Horizon- Twilight- Celestial sphere diagram.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Refraction: Astronomical refraction- tangential formula for refraction-Cassini's formula for refraction-Parallaxes-Aberration- Kepler's law of planetary motion.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	The Moon: Phases of moon- solar and Lunar eclipse- Seasons- Calendars.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Cosmology: Origin of universe: Big Bang theory- formation of solar system- Birth and death of stars-Galaxies.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Practical Astronomy: Telescopes and its handling - Constellations of stars- Nebulae- star clusters.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Astronomy for Degree Classes by S. Kumaravelu, Mission press, 9th edition (Reprint), 2002.
   - Unit 1: Chapter 1 - Sections: 1-9, 21-23
     Chapter 2 - Sections: 39-66, 69-74, 80-82, 86
     Chapter 3 - Sections: 87-89, 106-110, 111-113, 116
   - Unit 2: Chapter 4 - Sections: 117-124,129,130,131
     Chapter 5 - Sections: 135-137,141
     Chapter 6 - Sections: 146,149,150,153
     Chapter 7 - Sections: 190-193,195-197,199,202-203
   - Unit 3: Chapter 7 - Sections: 166-179,173-178,180
     Chapter 12 - Sections: 229-241,252
     Chapter 13 - Sections: 256-263,267-274,283
     Chapter 14 - Sections: 288,289,292-294
2. The rough guide to the universe by John Scalzi, Rough guide Ltd., 2nd edition, 2008
   - Unit 4: Part 1 - Sections: 1, 12, 13
   - Unit 5: Part 3 - Sections: 1, 2, 3

Suggested Readings

1. Extragalactic Astronomy and Cosmology by Peter Schneider Springer.
2. Astronomy for graduate and post graduate classes by Rukmani Ramachandran.
3. Astronomy- A self-teaching guide by Dinah. l. Moche, John Wiley & Sons Inc.

Web Resources

1. https://starchild.gsfc.nasa.gov/docs/StarChild/questions/question48.html.
2. https://www.cgg.org/index.cfm/library/bqa/id/118/what-are-origins-of-names-our-days-_months.html
3. https://www.timeanddate.com/calendar/aboutseasons.html.

4. http://www.hindupedia.com/en/Astronomy.
5. https://www.metmuseum.org/toah/hd/astr/hd_astr.htm
6. http://w.astro.berkeley.edu/~kalas/ethics/documents/coi/Modern%20Astronomy,%20the%20Bible,%20and%20Creation.pdf
7. Atlas of the universe by Sir Patrick Moore, e-book.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To describe the basic concepts in astronomy.	K1, K2
CO2	To demonstrate the theory of motion of celestial bodies.	K3
CO3	To analyze the occurrence of astronomical events.	K4
CO4	To assess the application of mathematics in astronomy.	K5
CO5	To arrange astronomical instruments and compile star maps.	K6

Course Code	UMT 5501
Course Title	Real Analysis - II
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. The concept of the limit of a function on the real line is studied.
2. The significance of the concepts of continuity, discontinuity and uniform continuity of real functions is imparted.
3. The concept of derivatives and its applications are discussed.
4. This course deals with the study of the Riemann integral and its properties.
5. The topology of real numbers is studied.

Course Objectives

1. To comprehend the notion of limit of a function and its properties.
2. To understand the concept of continuity of functions on the real line.
3. To realize the theoretical aspects and applications of derivatives of real functions.
4. To recognize the concepts of Riemann integral and its properties.
5. To visualize the topology of the real numbers.

Prerequisites	A deep knowledge about the real line and its properties.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Limits of functions - Sequential criterion for limits - Divergence criteria - Limit theorems - Some extensions of the limit concept - One-sided limit - Infinite limits - Limits at infinity.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Continuous functions - Sequential criterion for continuity - Discontinuity criterion - Combinations of continuous functions - Composition of continuous functions - Continuous functions on intervals - The maximum-minimum theorem - Location of roots	16	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

	theorem - Bolzano's intermediate value theorem - Preservation of intervals theorem - Nonuniform continuity criteria - Uniform continuity theorem - Lipschitz functions.		CO4 CO5	
III	The derivative - The chain rule - Caratheodory's theorem - Inverse functions - The mean value theorem - Interior extremum theorem - Rolle's theorem - L'Hospital's rules - Indeterminate forms - Cauchy mean value theorem - L'Hospital's rule I - L'Hospital's rule II - Other indeterminate forms - Taylor's theorem - Applications of Taylor's theorem.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Partitions and tagged partitions - Definition of the Riemann integral - Some properties of the integral - Boundedness theorem - Riemann integrable functions - Cauchy Criterion - Squeeze theorem - Classes of Riemann integrable functions - Additivity theorem - Fundamental theorem of calculus - Substitution theorem.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Open and closed sets in R - Open set properties - Closed set properties - Characterization of closed sets - Characterization of open sets - The Cantor set - Compact sets - Heine Borel theorem - Continuous functions - Global continuity theorem - Preservation of compactness.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, John-Wiley & sons, Inc. - 2011 - Fourth Edition.

Unit 1: Chapter 4 - Sections: 4.1: 4.1.1 - 4.1.10, 4.2: 4.2.1 - 4.2.9, 4.3: 4.3.1 - 4.3.16
Unit 2: Chapter 5 - Sections: 5.1: 5.1.1 - 5.1.8, 5.2: 5.2.1 - 5.2.8, 5.3: 5.3.1 - 5.3.10, 5.4: 5.4.1 - 5.4.6
Unit 3: Chapter 6 - Sections: 6.1: 6.1.1 - 6.1.10, 6.2: 6.2.1 - 6.2.7, 6.3: 6.3.1 - 6.3.7, 6.4: 6.4.1 - 6.4.3
Unit 4: Chapter 7 - Sections: 7.1: 7.1.1 - 7.1.7, 7.2: 7.2.1 - 7.2.13, 7.3: 7.3.1 - 7.3.9
Unit 5: Chapter 11 - Sections: 11.1: 11.1.1 - 11.1.10, 11.2: 11.2.1 - 11.2.6, 11.3: 11.3.1 - 11.3.6

Suggested Readings

1. Topology of metric spaces - S. Kumaresan - Alpha Science International Ltd - 2005 - First edition.
2. Real Analysis - K. Viswanatha Naik - Emerald Publishers - First Edition.
3. Methods of Real Analysis - Richard R Goldberg - Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi - 1970.
4. A first course in mathematical Analysis- D. Somasundaram, Choudhary D-Narosa publications, Corrected Edition, 2006.
5. Basic Analysis-I, Jiri Lebl, 2001, e-Book. (https://www.jirka.org/ra/realanal.pdf)

Web Resources

1. https://www.youtube.com/watch?v=kaVXVry47s8
2. https://www3.nd.edu/~lnicolae/Hon_Calc_Lectures.pdf

3. https://www.youtube.com/watch?v=mhi5TdWLUjs
4. https://www.youtube.com/watch?v=1diSwLMJpvs
5. https://bit.ly/3BGIyas

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the concepts of limits, continuity, differentiability and integrability of real functions and visualize topology on the real numbers.	K1, K2
CO2	To utilize the concepts of analysis of real functions in solving problems.	K3
CO3	To analyze the concepts of limits, continuity, differentiability, integrability of real functions and topology on real numbers.	K4
CO4	To access the results of limits, continuity, differentiability, integrability of real functions and topology on real numbers.	K5
CO5	To generate ideas and techniques in multi disciplines by utilizing the theory and applications of real analysis.	K6

Course Code	UMT 5502
Course Title	Linear Algebra
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. The concepts of linear algebra are extremely useful in various fields like Physics, Chemistry, Computer science, Economics, Engineering etc.
2. Linear algebra is an area of mathematics that matrices.
3. In this course, vector spaces and inner product spaces are studied.
4. The concept of linear transformation and its properties are introduced.
5. This course establishes the relationship between matrices and linear transformations and its applications.

Course Objectives

1. To understand the importance of linear algebra.
2. To investigate properties of vector spaces and subspaces.
3. To analyze different types of linear transformations.
4. To study about matrices and its canonical forms.
5. To discuss various types of matrices.

Prerequisites	Knowledge in vectors and matrices.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Vector Spaces: Elementary Basic Concepts - Linear Dependence and Bases - Hom (V, W) - dimension Hom (V, W).	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Inner Product Spaces: Inner Product Spaces - Schwarz Inequality - Orthogonal Space - Gram Schmidt orthogonalization process.	16	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Linear transformations: The Algebra of linear transformations - Characteristic Roots.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Matrices: Matrices - Canonical Forms: Triangular Forms.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Matrices (Continued): Hermitian, Unitary and Normal Transformations.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

I.N. Herstein, Topics in Algebra, Wiley India (P) Ltd., New Delhi, Second Edition, 2014.

Unit 1: Chapter 4 - Sections: 4.1, 4.2, 4.3.
Unit 2: Chapter 4 - Section: 4.4
Unit 3: Chapter 6 - Sections: 6.1 & 6.2
Unit 4: Chapter 6 - Sections: 6.3 & 6.4
Unit 5: Chapter 6 - Section: 6.10

Suggested Readings

1. Arumugam S., Isaac A. T, Modern Algebra, SciTech publications (India) Pvt. Ltd, 2015.
2. Santiago M. L, Modern Algebra, Tata McGraw - Hill Publishing Company Limited, New Delhi, Second Edition, 2001.

Web Resources

1. https://stepik.org/course/79/promo
2. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/
3. https://www.khanacademy.org/math/linear-algebra
4. https://www.math.ucdavis.edu/~linear/linear-guest.pdf
5. https://www.britannica.com/science/linear-algebra

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the basic concepts of Linear Algebra and Matrix Theory.	K1, K2
CO2	To realize and apply the theory of vector spaces, inner product spaces, matrices and different types of linear transformations.	K3
CO3	To determine solutions to problems and investigate the theoretical aspects of Dimension, Basis, Orthogonality matrices and various types of linear transforms.	K4
CO4	To evaluate problems based on the theorems of vector spaces, Matrices and Different Linear Transforms	K5
CO5	To create matrices, transformations and find solutions using the theories of vector spaces, Inner Product Spaces and Linear Transformations	K6

Course Code	UMT 5503
Course Title	Discrete Mathematics
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. Discrete Mathematics is a branch of mathematics that deals with the study of discrete objects and mathematical logic.
2. The main aim is to provide the mathematical foundation for data structures and algorithms.
3. The construction and evaluation of mathematical statements using logical principles are discussed.
4. This course investigates the basic algebraic structures such as semigroup, lattices and Boolean algebra in detail.
5. It helps to understand the logical theories and the relationship between the abstract mathematical structures with the discrete quantities.

Course Objectives

1. To motivate the students to think logically and apply the techniques in solving problems.
2. To analyze the outcomes of mathematical arguments using logical laws.
3. To understand the fundamental properties of lattices and Boolean algebra.
4. To apply the knowledge of abstract mathematical structures.
5. To explore the predicate calculus of the statement function and analyze their logical validity.

Prerequisites	Basic knowledge in group theory.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Mathematical Logic: Statement Formulae and Truth Tables, Conditional and Bi-conditional, Well-formed Formulae, Tautologies, Equivalence of Formulae, Duality Law Tautological Implications, Normal Forms, Disjunctive Normal Forms, Conjunctive Normal Forms, Principal Disjunctive Normal Forms, Principal Conjunctive Normal Forms.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	The Theory of inference for Statement Calculus and The Predicate Calculus: Validity using truth tables, Rules of Inference, Consistency of Premises and Indirect Method of Proof, Predicates, The statement Function, Variables and Quantifiers, Predicate Formulas, Free and Bound Variables, The Universe of Discourse - Valid Formulas and Equivalences - Theory of inference for the Predicate Calculus.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Semigroups and Monoids: Semigroups, Monoids, Homomorphism of Semigroups and Monoids, Sub semigroups and Submonoid.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Lattices: Lattices as Partially Ordered Set, Properties of Lattices, Lattices as Algebraic Systems, Sub lattices, Direct Product and Homomorphism.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Boolean Algebra: Basic properties, Subalgebra, Direct Product, and Homomorphism, Boolean Functions.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. J. P. Trembley, R. Manohar, Discrete Mathematical Structures with applications to Computer science, McGrew HillBook Co., second edition, 2001.
   Unit 1: Chapter 1 - Sections: 1.1, 1.2.1-1.2.4, 1.2.6-1.2.11, 1.3.1-1.3.4
   Unit 2: Chapter 1 - Sections: 1.4.1-1.4.3, 1.5.1-1.5.5, 1.6.1, 1.6.4
   Unit 3: Chapter 3 - Sections: 3.2.1-3.2.3
   Unit 4: Chapter 4 - Sections: 4.1.1-4.1.4
   Unit 5: Chapter 4 - Sections: 4.2-4.3

Suggested Readings

1. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, Prentice Hall of India, 2013.
2. Kenneth H Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill Pub. Co. Ltd, sixth edition, 2008.

Web Resources

1. https://notendur.hi.is/mbh6/html/_downloads/Discrete%20Mathematics%20and%20Its%20Applications%20-%20Kenneth%20Rosen%20(2012).pdf
2. https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_propositional_logic.htm
3. https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_predicate_logic.htm

4. https://www.tutorialspoint.com/discrete_mathematics/rules_of_inference.htm
5. https://www.javatpoint.com/discrete-mathematics-tutorial
6. https://www.tutorialspoint.com/discrete_mathematics/index.htm
7. https://nptel.ac.in/courses/111/107/111107058/
8. http://discrete.openmathbooks.org/dmoi3/dmoi.html

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand and identify the logical techniques and their applications.	K1, K2
CO2	To recognize and apply the concept of logic, inference theory, monoids, lattices and Boolean algebra.	K3
CO3	To analyze various forms of mathematical statements, its predicates and discrete structures.	K4
CO4	To interpret the validity of the formula functions and the existence of algebraic structures.	K5
CO5	To construct abstract structures using predicates, quantifiers and logical connectives.	K6

Course Code	UMT 5504
Course Title	Mathematical Tools for Analytics
Credits	3
Hours/Week	3
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. This course provides an introduction to MATLAB designed for beginners.
2. MATLAB is a tool for computation and visualization in an integrated environment.
3. It focusses on skill development in analyze programs for mathematical problems.
4. Topics covered include basic library functions, graphical representations and generating functions using MATLAB code.
5. The course emphasizes on the applications to mechanics using MATLAB.

Course Objectives

1. To impart basic knowledge of MATLAB in understanding commands for simple mathematical problems.
2. To familiarize with syntax, semantics, data-types and library functions.
3. To develop a top-down, modular and systematic approach for debugging MATLAB programs.
4. To design mathematical structures using plot functions.
5. To write function files for solving problems on mechanics.

Prerequisites	Basic knowledge in computer and mathematics

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Starting with MATLAB, Creating Arrays, Mathematical operations with arrays.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Using script files and Managing Data, Two dimensional plots, Programming in MATLAB.	8	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Polynomials, curve fitting and interpolation, three dimensional plots.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Advanced plotting techniques, Advanced Mathematics.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Operation with vectors, Moments, Couples	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. MATLAB: An introduction with applications, Amos Gilat, John Wiley & Sons, Inc., 2017, 6TH Edition.
   Unit 1: Chapter 1 to 3 - Sections: 1.1 - 1.10, 2.1 - 2.11, 3.1 - 3.9
   Unit 2: Chapter 4 to 6 - Sections: 4.1 - 4.7, 5.1 - 5.13, 6.1 - 6.6
   Unit 3: Chapter 8, 10 - Sections: 8.1 - 8.3, 10.1 - 10.4
2. MATLAB: A practical introduction to programming and problem solving, Stormy Attaway, Elsiver, Butterworth Heinemann Publication, 2017, 4th Edition.
   Unit 4: Chapter 12, 14 - Sections: 12.1 - 12.5, 14.1 - 14.7
3. Statics with MATLAB, Dan B. Marghitu, Mihai Dupac, Nels H. Madsen, Springer, 2013
   Unit 5: Chapter 1, 2 - Sections: 1.1 - 1.12, 2.1 - 2.7

Suggested Readings

1. Introduction to MATLAB 7 for Engineers, William J Palm III, McGraw Hill, 2005.
2. MATLAB with applications to engineering, physics and finance, David Baez-Lopez, CRC Press, 2010.
3. Solving Applied Mathematical Problems with MATLAB, Dingyu Xue Yangquan chen, CRC Press, 2008.
4. Introduction to MATLAB for Engineering Students, David Houcque, Northwestern University, 2005, ebook.

Web Resources

1. www.in.mathsworks.com
2. https://www.javatpoint.com/matlab-introduction
3. https://www.geeksforgeeks.org/introduction-to-matlab/
4. https://www.mathworks.com/videos/introduction-to-matlab-81592.html

5. https://www.educba.com/introduction-to-matlab/
6. MATLAB PROGRAMMING - Google Books

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

Cos	CO Description	Cognitive Level
CO1	To understand the mathematical library functions of MATLAB.	K1, K2
CO2	To apply programming skills in writing mathematical scripts.	K3
CO3	To analyze and examine MATLAB codes for debugging.	K4
CO4	To customize and visualize mathematical structures using plot functions.	K5
CO5	To generate MATLAB codes to handle mathematical concepts.	K6

Course Code	UMT 5505
Course Title	Mathematical Tools for Analytics Lab
Credits	3
Hours/Week	3
Category	Major Core (MC) - Lab
Semester	V
Regulations	2019

Course Overview

1. This course provides an introduction to MATLAB designed for beginners.
2. MATLAB is a tool for computation and visualization in an integrated environment.
3. It deals with creating and executing programs in MATLAB
4. Topics covered include basic library functions, graphical representations and generating functions using MATLAB code.
5. The course emphasizes on the applications to mechanics using MATLAB.

Course Objectives

1. To understand basic commands and its uses.
2. To familiarize with syntax, semantics, data-types and library functions.
3. To develop a top-down, modular and systematic approach for debugging MATLAB scripts.
4. To design mathematical structures using graphical features of MATLAB.
5. To write function files for solving problems on mechanics.

Prerequisites	Basic knowledge in computer and mathematics

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Basic commands - data types, Mathematical operators, Handling of Arrays	7	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Creating-saving and running m-files, Handling mathematical functions, two dimensional plots	8	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Curve fitting and interpolation, Three-dimensional plots, Data visualization - 2D and 3D plotting	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Advanced plotting techniques, Advanced Mathematics.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Computing moments and couples	7	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. MATLAB: An introduction with applications, Amos Gilat, John Wiley & Sons, Inc., 2017, 6^{TH} Edition.
   Unit 1: Chapter 1 to 3: Sections: 1.1 - 1.10, 2.1 - 2.11, 3.1 - 3.9
   Unit 2: Chapter 4 - 6 Sections: 4.1 - 4.7, 5.1 - 5.13, 6.1 - 6.6
   Unit 3: Chapter 8, 10. Sections: 8.1 - 8.3, 10.1 - 10.4
2. MATLAB: A practical introduction to programming and problem solving, Stormy Attaway, Elsiver, Butterworth Heinemann Publication, 2017, 4^{th} Edition.
   Unit 4: Chapter 12, 14. Sections: 12.1 - 12.5, 14.1 - 14.7
3. Statics with MATLAB, Dan B. Marghitu, Mihai Dupac, Nels H. Madsen, Springer, 2013
   Unit 5: Chapter 1 to 2 - Sections: 1.1 - 1.12, 2.1 - 2.7

Suggested Readings

1. Introduction to MATLAB 7 for Engineers, William J Palm III, McGraw Hill, 2005.
2. MATLAB with applications to engineering, physics and finance, David Baez-Lopez, CRC Press, 2010.
3. Solving Applied Mathematical Problems with MATLAB, Dingyu Xue Yangquan chen, CRC Press, 2008.
4. Introduction to MATLAB for Engineering Students, David Houcque, Northwestern University, 2005, ebook.

Web Resources

1. www.in.mathsworks.com.
2. https://www.javatpoint.com/matlab-introduction
3. https://www.geeksforgeeks.org/introduction-to-matlab/
4. https://www.mathworks.com/videos/introduction-to-matlab-81592.html
5. https://www.educba.com/introduction-to-matlab/

6. .MATLAB PROGRAMMING - Google Books

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the features of MATLAB and its uses.	K1, K2
CO2	To apply programming skills in writing mathematical script files.	K3
CO3	To write and examine program scripts and functions for debugging.	K4
CO4	To customize and visualize mathematical structures by using appropriate graphical features of MATLAB	K5
CO5	To generate MATLAB commands and codes to handle mathematical concepts.	K6

Course Code	UMT 5601
Course Title	Graph Theory
Credits	6
Hours/Week	6
Category	Major Elective (ME) - Theory
Semester	V
Regulation	2019

Course Overview

1. Graph theory is a branch of discrete mathematics dealing with the connection between objects.
2. Graph theory has emerging applications in characterizing social and parallel network problems by incorporating information from a multitude of structural parameters.
3. The aim of the course is to provide the basic knowledge of graphs and their applications.
4. The concept of trees in graphs is discussed with properties.
5. The mathematical aspects of computer-chip and scheduling issues are studied via graph structures.

Course Objectives

1. To understand the idea of graphs and their importance in computer science.
2. To apply graph-theoretical tools in solving real-life problems.
3. To realize the Euler and Hamiltonian circuits.
4. To understand the various graph structures and their properties in solving the underlying physical problems.
5. To use graph theory as a modelling tool related to problems in computer science.

Prerequisites	Basic knowledge on graphs.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Graphs - Applications of graphs - finite and infinite graphs - Incidence and degree - Isomorphism - Subgraphs - Walks, paths and circuits - connected graphs, disconnected graphs and components.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Euler Graphs - Operations on graphs - More on Euler graphs - Hamiltonian paths and circuits	15	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Trees - Some properties of trees - Pendant vertices in a tree - Distance and centers in a tree - Spanning trees -Spanning trees in a weighted graph.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Cut-sets - Some properties of cut-sets - All cut-sets in a graph - Fundamental circuits and cut-sets - Connectivity and separability.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Planar graphs - Kuratowski's two graphs - Different representations of a planar graph - Chromatic number and chromatic polynomials - Directed graph - Some types of digraphs.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, PHI Learning Pvt. Ltd, Delhi, 2019.
   Unit I: Chapter 1 - Sections: 1.1-1.5, Chapter 2 - Sections: 2.1-2.5
   Unit II: Chapter 2 - Sections: 2.6-2.9
   Unit III: Chapter 3 - Sections: 3.1-3.4, 3.7, 3.10
   Unit IV: Chapter 4 - Sections: 4.1-4.5
   Unit V: Chapter 5 - Sections: 5.2-5.4, Chapter 8 - Sections: 8.1, 8.3, Chapter 9 - Sections: 9.1, 9.2

Suggested Readings

1. G. Suresh Singh, Graph Theory, PHI Learning Pvt. Ltd., 2010.
2. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, Springer-Verlag New York, 2012.
3. S. Arumugam and S. Ramachandran, Invitation to Graph Theory, SciTech Publication Pvt. Ltd, 2015

Web Resources

1. https://www.geeksforgeeks.org/graph-types-and-applications/?ref=lbp
2. http://discrete.openmathbooks.org/dmoi3/sec_trees.html
3. https://www.javatpoint.com/planar-and-non-planar-graphs

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the basic ideas of graphs and developments in computer science.	K1, K2
CO2	To apply the connectivity, Euler, Hamiltonian and spanning trees of graphs in underlying communication related problems.	K3
CO3	To analyze the properties of cycle free structures.	K4
CO4	To compare the different graph-theoretical tools.	K5
CO5	To construct the various graphs and to obtain the important quantitative characteristics.	K6

Course Code	UMT 5602
Course Title	Fuzzy Sets and Applications
Credits	6
Hours/Week	6
Category	Major Elective (ME) - Theory
Semester	V
Regulation	2019

Course Overview

1. Fuzzy set theory deals with problems related to ambiguous and uncertainty.
2. The main aim of this course is to introduce the concepts of fuzzy set, fuzzy graphs and fuzzy relations.
3. This course deals with fuzzy models such as fuzzy cognitive maps, bidirectional associative mappings and its applications.
4. The working principles of fuzzy expert system and fuzzy process control are discussed.
5. It helps to understand Fuzzy logic techniques applied in commercial products and in analyzing social issues.

Course Objectives

1. To introduce the concept of fuzzy set theory and their basic operations.
2. To understand the concepts and properties of fuzzy relations and fuzzy graphs.
3. To describe the fuzzy matrix model and fuzzy cognitive maps of some real- world problems.
4. To explore and analyze the behavior of fuzzy associative memories and bidirectional associative memories models and demonstrate its application to cater social needs.
5. To apply fuzzy expert system and fuzzy control to solve problems.

Prerequisites	Basic knowledge of set theory, matrices and functions.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Introduction - Review of the notion of membership -The concept of a fuzzy subset - Dominance relation - Simple operations on fuzzy subsets-set if fuzzy subsets for E and M finite- Properties of the set of fuzzy subsets- Products and algebraic sum of two fuzzy subsets. Self-study: Survey on the historical development of fuzzy principles and fuzzy logic applications.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Introduction - Fuzzy graphs - Fuzzy relation -Composition of two fuzzy relation - Fuzzy subsets induced by a mapping - conditioned fuzzy subsets - properties of fuzzy binary relations - Transitive closure of a fuzzy binary relation- Paths in a finite fuzzy graph.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Similitude relation - Similitude fuzzy relations in a fuzzy preorder - Anti symmetry - Fuzzy order relations- Anti symmetry relations without loops- Dissimilitude relations- Resemblance relations -various properties of similitude and resemblance - various properties of fuzzy perfect order relation	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Basic Matrix theory- Basic concept of fuzzy matrices - basic concepts on Graphs - Description of fuzzy matrix model - Definition of Fuzzy cognitive maps with real world model representation - Definition and Illustration of Fuzzy Relational maps- Introduction to Bidirectional Associative memories (BAM) - model and their applications- Description of Fuzzy Associative Memories (FAM) model and their illustrations.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Fuzzy sets and expert system - Introduction to Expert system - Uncertainty Modeling in Expert systems- Applications- Fuzzy control- Introduction to Fuzzy control - Process of fuzzy control - Applications of Fuzzy Control.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Introduction to the Theory of Fuzzy Subsets Volume I, A Kaufmann, Academic Press, 1975.
   - Unit 1: Chapter 1 - Sections: 1 - 9
   - Unit 2: Chapter 2 - Sections: 10 - 19
   - Unit 3: Chapter2 - Sections: 20 - 28, 30
2. Elementary Fuzzy Matrix Theory and Fuzzy Models for Social Scientists, W. B. Vasantha Kandasamy, Florentin Samrandache, K. Iilanthenrai, E-Book, 2007.
   - Unit 4: Chapter 1 - Sections: 1.1 - 1.3
     Chapter 2 - Sections: 2.1 - 2.5
3. Fuzzy Set Theory and Its Applications, Zimmermann, Kluwer Academic Publishers, 1996.
   - Unit 5: Chapter 10 - Sections: 10.1 ,10.2.3

Suggested Readings

1. Neural Networks and Fuzzy Systems, Bart Kosko, Printice-Hall, INC., New Jersey, 1992.

2. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence, Bart Kosko, Printice-Hall, INC., New Jersey, 1992.
3. Fuzzy Graphs and Fuzzy Hypergraphs, John N. Mordeson, Premchand S. Nair, Physica-Verlag, Springer Verlag Publisher, USA, 2000.
4. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J Klir and Bo Yuan, Printice-Hall, INC., New Jersey 2002.
5. Applied Fuzzy Arithmetic, An Introduction with Engineering Applications, Michael Hanss, Springer Publishers, Stuttgart, Germany, 2005.

Web Resources

1. https://www.javatpoint.com/fuzzy-logic
2. https://www.tutorialspoint.com/fuzzy_logic/index.html

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand and recognize the development of fuzzy theory and its applications.	K1, K2
CO2	To apply and solve social and engineering problems related to fuzzy set theory.	K3
CO3	To analyze different fuzzy models and interpret the results.	K4
CO4	To compare different Fuzzy models for a problem and assess their results.	K5
CO5	To create models for real life situations using fuzzy theory.	K6

Course Code	UMT 6501
Course Title	Complex Analysis
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	VI
Regulation	2019

Course Overview

1. Complex analysis is one of the significant areas of mathematics with applications in science and engineering.
2. This course deals with the fundamental notions of complex numbers and complex variables.
3. It also facilitates developing analytic functions.
4. Various techniques in evaluating contour integrals are studied.
5. It deals with residue calculus and bilinear transformation.

Course Objectives

1. To understand the importance of complex valued functions.
2. To apply the fundamental principles and theoretical concepts of complex analysis in problem solving.
3. To derive and utilize formulae in evaluating integrals and generating power series.
4. To classify the types of singularities of analytic functions.
5. To realize the mapping in the complex plane through linear fractional transformations.

Prerequisites	Fundamental knowledge in mathematical analysis.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Complex numbers - sums and products - basic algebraic properties - vectors and moduli - complex conjugates - exponential form - Arguments - roots of complex numbers - regions in the complex plane - functions of a complex variable - mappings - Limits - Theorems on limits - continuity - derivatives - differentiation formulas - Cauchy - Riemann equations - sufficient conditions for differentiability - Polar coordinates.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Analytic functions - Examples - Harmonic functions - Integrals - Derivatives of functions - Definite Integrals of functions - Contours - Contour integrals - Upper bounds for moduli of contour integrals - Anti derivatives - Cauchy - Goursat Theorem (Statement only) - Simply connected Domains (Statements of the theorems) - Cauchy integral formula - Extension of Cauchy integral formula (Statement only).	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Liouville's theorem and Fundamental theorem of Algebra - Maximum Modulus Principle (Statement only) - Convergence of Sequences - Convergence of series - Taylor's Series - Proof of Taylor's theorem - Laurent Series.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Isolated Singular points - Residues - Cauchy Residue theorem - Three types of isolated singular points - Residues at poles - Examples - Evaluation of improper integrals - Definite integrals involving sines and cosines.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Argument Principle - Rouche's Theorem - Linear Transformations - The transformation (1/z) - Linear Fractional Transformations -conformal mapping.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Complex Variables and Applications - James Ward Brown and Ruel V. Churchill - McGraw Hill Education - 2004 - Eighth Edition.
   - Unit 1: Chapter 1 - Sections: 1, 2, 4, 5, 6, 8, 9, 11
     Chapter 2 - Sections: 12, 13, 15, 16, 18 - 23
   - Unit 2: Chapter 2 - Sections: 24 - 26
     Chapter 4 - Sections: 37- 40, 43, 44, 46, 48, 50, 51
   - Unit 3: Chapter 4 - Sections: 53, 54
     Chapter 5 - Sections: 55 - 58, 60
   - Unit 4: Chapter 6 - Sections: 68, 69, 70, 72, 73, 74
     Chapter 7 - Sections: 78, 85
   - Unit 5: Chapter 7 - Sections: 86, 87
     Chapter 8 - Sections: 90, 91, 93
     Chapter 9 - Section: 101

Suggested Readings

1. Complex Analysis - S. Arumugam, T. Isaac, Somasundaram - Scitech Publications - 2015.

2. Foundations of complex analysis - S. Ponnusamy - Narosa Publishing House - 2011.
3. Complex Analysis - Joseph Bak, Donald J. Newman - Springer - 3rd edition - 2010.
4. Complex Variables (Schaum's Outlines) - Murray Spiegel, Seymour Lipschutz, John Schiller, Dennis Spellman - McGraw Hill Education - 2nd edition - 2017.
5. Complex Analysis - Lars Ahlfors - McGraw Hill Education - 3rd edition - 2017.

Web Resources

1. https://ocw.mit.edu/courses/mathematics/18-703-modern-algebra-spring-2013/
2. http://www.math.clemson.edu/~macaule/classes/m20_math4120/
3. https://www.khanacademy.org/math
4. https://www.mathway.com/Algebra
5. https://ocw.mit.edu/courses/mathematics/18-703-modern-algebra-spring-2013/

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the fundamental notions of theory of complex variables.	K1, K2
CO2	To apply various techniques in evaluating problems on analytic functions, integrals, power series and mappings by elementary functions.	K3
CO3	To analyze the concepts of analyticity, power series, contour integrals and linear fractional transformations.	K4
CO4	To evaluate problems on integration, power series and bilinear transformation.	K5
CO5	To construct analytic functions, contour integrals in determining improper integrals and to generate power series for analytic functions.	K6

Course Code	UMT 6502
Course Title	Operations Research
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	VI
Regulation	2019

Course Overview

1. Operations research deals with the study of scientific and mathematical methods used for decision making and problem solving.
2. The main aim of this course is to understand the representation of real-life problems as mathematical models and apply suitable algorithms to find their optimal solutions.
3. Finding the optimal solution of a linear programming problem using simplex methods is explained.
4. This course helps to find the optimal solutions of transportation and assignment problems and optimal strategies for winning a game.
5. The analysis of network models as a representation of real-life problems is done elaborately.

Course Objectives

1. To understand the formulation of a linear programming problem and find its optimal solution.
2. To solve transportation and assignment problems using different methods.
3. To find optimal strategies to solve games formed in conflict and competitive environments.
4. To understand operations, research techniques used for planning, scheduling and controlling large and complex projects.
5. To get motivation to take up a project to solve real life problems by adopting the techniques of operations research.

Prerequisites	Basic knowledge in algebra and probability distributions.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Linear programming - Formulation of LPP - Graphical solution -Simplex algorithm	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Duality - Dual Simplex algorithm - Big M method (Simple problems)	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Transportation -Balanced and Unbalanced problems - Assignment Problem - Balanced and Unbalanced problems.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Theory of Games - Optimal solutions of two persons zero sum games - Mixed strategies - Solutions by graphical method - Solutions of m x n games by graphical method - Dominance principle	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Network Analysis - Network definitions - Shortest route problem - Minimal spanning tree problem - Project scheduling by PERT and CPM	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. J K Sharma, Operations Research, Theory and applications, Macmillan Publications India, 2007, Third Edition.
   Unit 1: Chapter 2 - Section: 2.8, Chapter 3 - Sections: 3.1, 3.2, 3.3.
   Unit 2: Chapter 4 - Sections: 4.1, 4.2, 4.3, 4.4, Chapter 5 - Sections: 5.1, 5.2
   Chapter 27 - Sections: 27.1, 27.2
   Unit 3: Chapter 9 - Sections: 9.1,9.2,9.3,9.4,9.5, 9.6, 9.7
   Chapter 10 - Sections: 10.1,10.2,10.3,10.4
   Unit 4: Chapter 12 - Sections: 12.1,12.2,12.3,12.4,12.5,12.6
2. Hamdy A. Taha, Operations Research - An Introduction, Pearson publications, 2014, Seventh Edition.
   Unit 5: Chapter 6 - Sections: 6.1, 6.2, 6.3,6.3.1,6.4, 6.4.1, 6.4.2, 6.5, 6.5.1, 6.5.2, 6.5.5

Suggested Readings

1. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag, Preetam Basu, Introduction to Operational Research, Tama McGraw Hill Ltd., New Delhi, 2012.
2. C. R. Kothari, An Introduction to Operational Research, Vikas Publishing house Pvt. Ltd., Third Edition, 2009.
3. S. D. Sharma, Operations Research - Theory, Methods and Applications, Kedar Nath Ram Nath, 2014.
4. G. Srinivasan, Operations Research: Principles and Applications, Prentice Hall of India, e-Book, 2010.

5. P. Mariappan, Operations Research: An Introduction, Pearson, e-book, First Edition, 2013.

Web Resources

1. https://web.itu.edu.tr/topcuil/ya/OR.pdf
2. https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em8720.pdf
3. https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_3/M3L5_LN.pdf
4. https://ocw.ehu.eus/pluginfile.php/40935/mod_resource/content/1/5_Transportation.pdf
5. https://hithaldia.in/faculty/sas_faculty/Dr_M_B_Bera/Lecture%20note_8_CE605A&CHE705B.pdf
6. https://bit.ly/3lC8Ipq
7. https://nptel.ac.in/courses/111/104/111104027/

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the principles of linear programming problems, theory of games and network analysis.	K1, K2
CO2	To compute optimal solutions of linear programming problems, find optimal strategies to win a game and optimal schedule of a given project by suitable algorithms.	K3
CO3	To analyze the optimization techniques of linear programming, theory of games and network analysis in solving real world problems.	K4
CO4	To evaluate the concepts in linear programming and game theory and to estimate the optimal schedule of a project.	K5
CO5	To design a mathematical model for an optimization problem in real life by adopting the techniques of operations research.	K6

Course Code	UMT 6503
Course Title	Mechanics
Credits	6
Hours/Week	6
Category	Major Core (MC) - Theory
Semester	VI
Regulation	2019

Course Overview

1. Mechanics deals with the study of bodies under the influence of forces either in rest or motion.
2. The main aim of this course is to analyze the effect of forces acting on a system.
3. This course provides the study of mathematical and physical principles along with their applications to the behavior of objects.
4. In this course the motion of the projectile and moment of inertia of the system are studied.
5. This course also facilitates the visualization of mathematical models.

Course Objectives

1. To introduce the basic principles of forces and analyze its effect on the system.
2. To understand the concepts of parallel forces, moments of forces and the principles behind them.
3. To determine the resultant of the system of forces acting on the body, moment of forces and the motion of inertia of the body.
4. To apply Newton's laws of motion to solve various problems.
5. To explore and analyze the behavior of a projectile and its trajectory.

Prerequisites	Basic knowledge in physics.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Introduction: Force- Types of forces- Equilibrium - Equilibrium of two forces - Principle of the Transmissibility of a force. Forces Acting at a point: Resultant and Composition - Simple case of finding the resultant - Parallelogram of Forces - Analytical expression for the resultant of two forces acting at a point - Triangle of forces- perpendicular triangular of forces- converse of the triangle of forces - Polygon of Forces - Lami's theorem- Extended form of the parallelogram law of forces - Resolution of a force - components of a force along two given direction - Theorem on resolved parts - Resultant of any number of forces acting at a point (Graphical and analytical	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	methods) - conditions of equilibrium of any number of forces acting upon a particle.			
II	Parallel Forces and Moments: Introduction - Resultant of two like parallel forces acting on a rigid body- Resultant of two unlike parallel forces acting on a rigid body - condition of equilibrium of three coplanar parallel forces - center of two parallel forces - moment of a force - Physical significance of the moment of a force - Geometrical representation of a moment - sign of a moment- unit of moment - Varigon's theorem of moments- Generalized theorem of moments (Principle of Moments)- Moment of a force about an axis - Couples - Equilibrium of two couples - Equivalence of two couples- Couples in parallel planes - Representation of a couple by a vector - Resultant of a coupe and a force	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Laws of Motion: Introduction -Momentum- Newton's Laws of motion - Parallelogram law of Forces - Absolute unit of forces - Weights- Gravitational units of forces- Distinction between Mass and weight - conservation of linear momentum - Force of friction - Motion of a particle on a rough horizontal plane under the action of a constant forces - Motion of a particle up a rough inclined plane under the action of a constant force - Pressure of a body resting on a moving horizontal plane - Motion of connected particles - Atwood's machine.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Projectiles: Definitions - Two fundamental principles - path of a projectile - Characteristics of the motion of the projectile - Range on an inclined plane- path of a particle projected horizontally from a point at a certain height above the ground - maximum value of the horizontal range of a projectile - various possible directions of projection-velocity of the projectile in magnitude and direction at the end of time t.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Moment Of Inertia: Definition -Theorem of Parallel Axes - Theorem of perpendicular Axes - Moment of Inertia of some standard geometrical shapes: thin uniform rod - Rectangular lamina - uniform rectangular parallelepiped - Uniform circular ring - Uniform circular disc - Uniform elliptic lamina - Solid sphere - Hollow sphere- solid right circular cone - Hollow cone. Dr. Routh's rules.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Dr. M.K Venkataraman, Statics, Agasthiar publications, 19th edition, 2018.
   Unit 1: Chapter I - Sections: 1.1 - 1. 6, Chapter II - Sections: 2.1 - 2.16
   Unit 2: Chapter III - Sections: 3.1 - 3.14, Chapter IV - Sections: 4.1 - 4.3, 4.7
2. Dr. M.K Venkataraman, Dynamics, Agasthiar publications, 18th edition, 2017.
   Unit 3: Chapter IV - Sections: 4.1 - 4.23

Unit 4: Chapter VI - Sections: 6.1 - 6.15
Unit 5: Chapter XII - Sections: 12.1 - 12.5

Suggested Readings

1. K.V. Naik and M.S. Kasi, Statics, Emerald Publishers, 1987, First Edition.
2. K.V. Naik and M.S. Kasi, Dynamics, Emerald Publishers, 1987, First Edition.
3. D. S. Kumar, Statics and Dynamics, S. K. Kataria & sons, 2013.

Web Resources

1. https://www.youtube.com/watch?v=5aHaf0KlT9s
2. https://www.youtube.com/watch?v=bL3DZTft4DU&feature=youtu.be
3. https://www.youtube.com/watch?v=_jbXsSlqUg4&feature=youtu.be
4. https://www.youtube.com/watch?v=XjwjL_7OsU8&feature=youtu.be
5. https://www.youtube.com/watch?v=e7CnGZYcsAE
6. https://www.youtube.com/watch?v=BYtsu8j6N7I
7. https://www.youtube.com/watch?v=u5oSQg0vcp4
8. https://www.youtube.com/watch?v=W61RfotNmTI&feature=youtu.be
9. https://www.youtube.com/watch?v=R8wKV0UQtlo&t=15s

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand and recognize different force systems, moments, couple and projectiles.	K1, K2
CO2	To realize mechanical problems as mathematical models and examine their behaviours.	K3
CO3	To investigate the theoretical aspects of mechanics in correlation with environmental studies.	K4
CO4	To analyze and evaluate the resultant force and the motion of a particle under the influence of forces.	K5
CO5	To construct mechanical models and demonstrate its application to cater real life problems.	K6

Course Code	UMT 6701
Course Title	Numerical Methods using C
Credits	3
Hours/Week	4
Category	Major Skill (MS) - Theory
Semester	VI
Regulation	2019

Course Overview

1. Numerical methods, branch of mathematics applied in several disciplines of science and technology.
2. This course is an introduction to numerical methods for solving mathematical problems.
3. The course aims to acquire knowledge in finding numerical solutions to an algebraic equation, interpolation.
4. Acquiring knowledge in numerical differentiation and integration is focused.
5. Numerical approximation techniques and their implementation in computer science using the C programming language are dealt with.

Course Objectives

1. To convert a system of linear equations into matrix form and acquire knowledge to solve them using Gauss elimination and Gauss-Seidel methods.
2. To find approximate solutions to the functions using iterative methods.
3. To utilize various interpolation techniques in obtaining approximate interpolation of discrete data in real-life situations.
4. To evaluate numerical calculations of problems in differentiation and integration.
5. To design algorithms and program codes in solving real-life problems.

Prerequisites	Basic knowledge in algebra and computer.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Solutions to simultaneous linear equations: Gaussian elimination, Gauss-Seidel iterative method.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6.

II	Solutions of Algebraic and Transcendental Equations: Bisection method - Newton-Raphson method - Successive approximation method - Regula Falsi method.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6.
III	Polynomial Interpolation: Interpolation with equal and unequal intervals - Newton's Forward interpolation formula - Newton's Backward interpolation formula - Divided difference formula - Lagrange's interpolation formula.	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6.
IV	Central Difference Interpolation Formula: Gauss interpolation formula - Stirling's formula -Bessel's formula - Everett's formula (Only application of these formulae. No proof required).	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6.
V	Numerical Differentiation and Integration: Trapezoidal rule - Simpson's $1/3^{rd}$ and $3/8^{th}$ rule. Numerical solutions of ordinary differential equations- Euler's methods with its modifications - Taylor's series method -Runge- Kutta method.	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6.

Text Books

Numerical Methods, Dr. V. N. Vedamurthy, Dr. N. Ch. S. N. Iyengar, Vikas Publishing house PVT. Ltd 1998

Unit 1: Chapter 4 - Sections: 2,10
Unit 2: Chapter 3 - Sections: 2-5
Unit 3: Chapter 6 - Sections: 2,3. Chapter 8 - Sections: 1-5
Unit 4: Chapter 7 - Sections: 2,3,6,8. Chapter 9 - Sections: 1-4
Unit 5: Chapter 9 - Sections: 6,8,9,10, Chapter 11 - Section: 4,5,610,11,12,14,15.

Books for Reference

1. Numerical Algorithms computations in Science & Engineering, E.V. Krishnamurthy & S. K. Sen., Affiliated East-West Press Pvt. Ltd., 1994.
2. Numerical Methods, Kandasamy. P Sultan and sons private ltd, 1997.
3. Numerical Methods and Statistical Techniques Using C, Manish Goyal, Lakshmi publication, 2009.
4. Numerical Methods for engineers D. Vaughan Griffiths, I. M. Smith, Chapman &Hall, CRC, 2006.

Web Resources

1. https://books.google.co.in/books?id=anwHfrXY8_wC&printsec=frontcover#v=onepage&q&f=false
2. https://numericalmethodstutorials.readthedocs.io/en/latest/
3. Elementary Numerical Analysis: An Algorithmic Approach by Samuel Daniel Conte (e-book)

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand various concepts in numerical methods.	K1, K2
CO2	To apply different techniques in obtaining approximate solutions to intractable mathematical problems.	K3
CO3	To utilize several methods in computing solutions for algebraic and transcendental equations, interpolation, differentiation and integration.	K4
CO4	To evaluate and interpret results on real life problems using appropriate numerical techniques.	K5
CO5	To implement algorithms to the problems of numerical methods using C language.	K6

Course Code	UMT 6702
Course Title	Mastering Mathematics using PYTHON
Credits	3
Hours/Week	4
Category	Major Skill (MS) - Theory
Semester	VI
Regulation	2019

Course Overview

1. PYTHON is an interpreted, interactive and object-oriented language based on syntax and powerful set of libraries.
2. This course is an introduction to the PYTHON programming language for students even without prior programming experience.
3. It mainly focuses the development of skills on practical training and problem solving.
4. Concepts including data types, control flow, graphical user interface-driven applications for mathematical related codes/scripting studied.
5. It enables the students in formulating the web scripting (server-side), mathematics manipulation and software development.

Course Objectives

1. To understand the basics of PYTHON.
2. To introduce different libraries of PYTHON and their applications.
3. To solve mathematical problems using PYTHON scripting.
4. To motivate PYTHON learning in-depth way.
5. To enhance the skill development of students by manipulating PYTHON with mathematical concepts.

Prerequisites	Basic knowledge in computer science

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Working with Numbers: Basic Mathematical Operations - Labels: Attaching Names to Numbers- Different Kinds of Numbers- Getting User Input - Writing Programs That Do the Math for You - Simple Programs.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Visualizing Data with Graphs: Understanding the Cartesian Coordinate Plane- Working with Lists and Tuples - Creating Graphs with Matplotlib- Plotting with Formulas- Simple Programs.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K6
III	Algebra and Symbolic Math with SymPy: Defining Symbols and Symbolic Operations - Working with Expressions - Solving Equations - Plotting Using SymPy - Simple Programs.	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Drawing Geometric Shapes and Fractals: Drawing Geometric Shapes with Matplotlib's Patches - Drawing Fractals - Simple Programs.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Solving Calculus Problems: What Is a Function? - Assumptions in SymPy - Finding the Limit of Functions - Finding the Derivative of Functions - Higher-Order Derivatives and Finding the Maxima and Minima - Finding the Global Maximum Using Gradient Ascent - Finding the Integrals of Functions - Simple Programs.	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

Doing Math with PYTHON - Use Programming to Explore Algebra, Statistics, Calculus, and More!, Amit Saha, No Starch Press, 2015

Unit I: Chapter 1- Working with Numbers.
Unit II: Chapter 2 - Visualizing Data with Graphs.
Unit III: Chapter 4 - Algebra and Symbolic Math with SymPy.
Unit IV: Chapter 6 - Drawing Geometric Shapes and Fractals.
Unit V: Chapter 7 - Solving Calculus Problems.

Suggested Readings

1. Mathematics and PYTHON Programming, J C Bautista, Lulu Press, 2015.
2. Numerical PYTHON, Robert Johnson, A Press, 2018, II.
3. Core PYTHON Programming, Wesley. J. Chun, Pearson, 2012, III.

Web Resources

1. Python Exercises, Practice, Solution - w3resource
2. List of Free Python Resources [Updated June 2021] - (hakin9.org)

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the basic mathematical library functions using PYTHON libraries.	K1, K2
CO2	To acquire the knowledge of *SymPy* library in expressing mathematical equations.	K3
CO3	To analyze *matplotlib* functions in geometric shapes, fractals and for solving problems.	K4
CO4	To design a few mathematical functions using *SymPy*, available in the PYTHON standard library and examine problems.	K5
CO5	To create graphs from data sets and analyze problems on algebra and calculus by using *matplotlib* and to visualize geometrical shapes.	K6

Course Code	UMT 6706
Course Title	Programming Numerical Methods using C & PYTHON Lab
Credits	3
Hours/Week	4
Category	Major Skill (MS) - Lab
Semester	VI
Regulation	2019

Course Overview

1. This course is an introduction to basics of C and PYTHON programming language to solve mathematical functions.
2. It mainly focuses on the development of skills on practical training and problem solving in C and PYTHON.
3. Numerical approximation techniques and their implementation in computer science using the C programming language are dealt with.
4. Concepts including data types, control flow, graphical user interface-driven applications for mathematical related codes/scripting studied in PYTHON.
5. It enables the students in formulating the web scripting (server-side), mathematics manipulation and software development in PYTHON.

Course Objectives

1. To apply C programming to find numerical solutions to problems.
2. To write the mathematical functions in C language.
3. To manipulate different libraries of PYTHON and their applications
4. To solve mathematical problems using PYTHON scripting.
5. To enhance the skill development of students by manipulating PYTHON with mathematical concepts.

Prerequisites	Basic knowledge in computer and mathematics

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Gauss Elimination method - Gauss Seidel method - Regula Falsi method - Newton Raphson method - Newton's Forward Interpolation.	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Lagrange's Interpolation - Trapezoidal Method - Simpson's 1/3rd and 3/8th Rule - Euler Method - Runge Kutta Method.	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Basic Mathematical Operations:- Odd & Even Vending machine - Multiplication Table Generator - Unit Convertor - Fraction Calculator. Visualizing Data with Graphs: Cartesian Coordinate Plane:- Graphing the annual average temperature - comparing temperature - Quadratic Function - Drawing the trajectory.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Algebra and Symbolic Math with SymPy: Factorizing - Expanding Expressions - How to substitute values in algebraic expressions - Printing a Series - Calculate value of the series - Conversion of Strings to Mathematical Expressions - Solving: Quadratic Equations - System of Linear Equations - Single value Inequalities - Plotting. Drawing Geometric Shapes and Fractals: Drawing Geometric Shapes - Animated figures - Projectile Trajectories - Transformation of point into plane - Packing Circles into a square:- Drawing the Sierpin´ski Triangle - Exploring Hénon's Function - Drawing the Mandelbrot Set.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Solving Calculus Problems: Finding the Limit of Functions - Finding the Derivative of Functions - A Derivative Calculator - Calculating Partial Derivatives - Higher-Order Derivatives and Finding the Maxima and Minima - Finding the Global Maximum Using Gradient Ascent - Finding the Integrals of Functions - Probability Density function - Area between two curves - Length of a curve.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Numerical Methods in Engineering & Science: C, C++, AND MATLAB, B. S. Grewal, Mercury Learning and Information, 2019
   Unit I: Chapter 14 - Sections: 14.4, 14.5, 14.8, 14.11, 14.16
   Unit II: Chapter 14 - Sections:14.17, 14.20, 14.21, 14.22, 14.24
2. Doing Math with PYTHON - Use Programming to Explore Algebra, Statistics, Calculus, and More!, Amit Saha, No Starch Press, 2015
   Unit III: Chapter 1 - Working with Numbers
   Chapter 2 - Visualizing Data with Graphs
   Unit IV: Chapter 4 - Algebra and Symbolic Math with SymPy
   Chapter 6 - Drawing Geometric Shapes and Fractals

Unit V: Chapter 7 - Solving Calculus Problems
Suggested Readings 1. Manish Goyal , Numerical Methods and Statistical Techniques Using C, Lakshmi publication, 2009. 2. Programming in ANSI C, 8/E, McGraw Hill Education Private Limited, 2019. 3. Mathematics and PYTHON Programming, J C Bautista, Lulu Press, 2015. 4. Numerical PYTHON, Robert Johnson, A Press, 2018, II. 5. Core PYTHON Programming, Wesley. J. Chun, Pearson, 2012, III.
Web Resources 1. https://numericalmethodstutorials.readthedocs.io/en/latest/ 2. http://www.dailyfreecode.com/Tutorial_Simple_C_Programming-15/Numerical-Methods-265.aspx 3. Python Math: Exercises, Practice, Solution - w3resource 4. List of Free Python Resources [Updated June 2021] - (hakin9.org)

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the features of C and PYTHON and its uses.	K1, K2
CO2	To apply programming skills in writing mathematical script files.	K3
CO3	To write and examine program scripts and functions for debugging.	K4
CO4	To evaluate and interpret results on real life problems using appropriate numerical techniques and to customize and visualize mathematical structures by using appropriate graphical features of PYTHON	K5
CO5	To implement algorithms to the problems of numerical methods in C language and to analyze problems on algebra and calculus by using *matplotlib*.	K6

COURSE DESCRIPTORS

(Offered to other Departments)

Course Code	UMT 1301
Course Title	Mathematics for Physics - I
Credits	3
Hours/Week	6
Category	Allied Required (AR) - Theory
Semester	I
Regulation	2019

Course Overview

1. This course aims to impart the basic knowledge of mathematics in the field of Physical sciences.
2. The aim of this course is to cover various mathematical areas such as differentiation, infinite series, Laplace transforms, matrices and probability.
3. The significance of differentiation and Laplace transforms is discussed.
4. This course helps to study the behavior of the given infinite series.
5. This course also gives knowledge on the theory of probability and statistics.

Course Objectives

1. To evaluate the derivative of a function and examine its applications geometrically.
2. To analyze the convergence and divergence of an infinite series.
3. To apply the concept of Laplace transforms for solving differential equations.
4. To understand the types and properties of matrices and evaluate eigen values and eigen vectors.
5. To acquire knowledge of probability distributions and statistical parameters.

Prerequisites	Basic knowledge in calculus and algebra.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Differentiation - The nth derivative - Leibnitz theorem (no proof) and applications - Sub tangent and subnormal in Cartesian and polar coordinates - Slope of a curve and angle of intersection of curves in polar coordinates - Maxima and minima of functions of one variable.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Series - Convergence and divergence of series - Test for convergence - Comparison test - Ratio Test - Binomial, exponential and logarithmic series (no proof) - Application to summation	16	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Laplace transform of elementary functions and periodic functions - Inverse transform - Application to differential equations.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Matrices - Types of Matrices - Inverse of a Matrix - Characteristic equation of Matrix - Cayley Hamilton Theorem (no proof) - Solving problems using Cayley Hamilton Theorem - Eigen values and Eigen vectors - Solving system of equations using matrix inverse method- Cramer's rule and Gauss Elimination Method.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Probability - Basic Terminology - Mean - Standard deviation- Correlation - Rank Correlation -Regression - Binomial, Poisson and Normal distributions.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Calculus Vol. 1, Narayanan, S and Manicavachagom Pillai T.K, S. Viswanathan Printers & Publishers 1996.
   Unit 1: Chapter 3 - Sections: 1.1 - 1.4, 2.1, Chapter 5 - Sections: 1.1 - 1.5
   Chapter 9 - Sections: 1.2, 1.4, 2, 4.1 - 4.5
2. Algebra Vol. 1, Manicavachagom Pillai T.K, Natarajan T and Ganapathy K.S., S. Viswanathan Printers & Publisher 1994.
   Unit 2: Chapter 2 - Sections: 8 - 14, 16, Chapter 3 - Section: 10, Chapter 4 - Sections: 3, 5 - 7, 9
3. Calculus Vol. 3, Narayanan, S and Manicavachagom Pillai T. K., S. Viswanathan Printers & Publishers 1996.
   Unit 3: Chapter 5 - Sections: 1 - 9
4. Matrices, P K Mittal, Vrinda Publications (P) Ltd, 2007, 1.
   Unit 4: Chapter 1 - Sections: 1.1, 1.2, Chapter 2 - Sections: 2.1, 2.3 - 2.8, Chapter 4 - Sections: 4.1, 4.3, Chapter 7 - Sections: 7.1 - 7.3, 7.5, Chapter 9 - Sections: 9.1, 9.3, 9.4
5. Fundamentals of Mathematical Statistics, S.P. Gupta, and V.K. Kapoor Sultan Chand and Sons Publishers 2002, 1.
   Unit 5: Chapter 2 - Sections: 2.5, 2.13.4, Chapter 3 - Sections: 3.1 - 3.5,
   Chapter 8 - Sections: 8.4, 8.4.1, 8.4.6, 8.5, 8.5.2, 8.5.5, 8.5.9
   Chapter 9 - Sections: 9.2, 9.2.1, 9.2.5, 9.2.14,
   Chapter 10 - Sections: 10.4, 10.4.2, 10.7.1, Chapter 11 - Sections: 11.2, 11.2.1, 11.2.2

Suggested Readings

1. Probability: A Graduate Course (e-book), Allan Gut, Springer, New York 2012
2. Vector Analysis, Duraipandian. P, Emerald Publishers 1984
3. Allied Mathematics Vol 1, (e-book), P. Kandasamy, K. Thilagavathy, S Chand, 2014
4. Differential Calculus, Shanthi Narayanan. S, Chand & Co ,1964
5. Allied Mathematics, Singaravelu. A, A. R. S.Publications, 2014
6. Allied Mathematics, Vittal,P R, Margham Publications, 2015

Web Resources

1. https://www.youtube.com/watch?v=V1AKAkGJlN8
2. https://www.youtube.com/watch?v=rowWM-MijXU
3. https://courses.lumenlearning.com/boundless-algebra/chapter/introduction-to-matrices/
4. https://bit.ly/3v8nTK8

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO 1	To understand the fundamentals of derivatives, series, matrices and statistics.	K1, K2
CO 2	To employ appropriate mathematical methods and techniques in solving problems.	K3
CO 3	To analyze the applications of calculus, transforms, algebra and correlation parameters.	K4
CO 4	To evaluate the solution of differential equations using Laplace transforms, the extremal values of differentiable functions and the characteristic values of matrices.	K5
CO 5	To formulate and solve problems in physics using various techniques of calculus, matrices, transforms and probability theory.	K6

Course Code	UMT 1302
Course Title	Mathematics For Chemistry - I
Credits	6
Hours/Week	6
Category	Allied Required (AR) - Theory
Semester	I
Regulation	2019

Course Overview

1. The main aim of this course is to give mathematical knowledge applied in the field of chemistry.
2. This course deals with various techniques in calculus.
3. This course helps to study infinite series expansions.
4. The significance of De Moivre's theorem in trigonometric functions is discussed in detail.
5. This course gives knowledge on probability and distributions.

Course Objectives

1. To understand the various concepts on differentiation.
2. To introduce the infinite series and find the sum of series.
3. To apply the concepts of integration in solving problems related to chemistry.
4. To find the series expansion of trigonometric functions.
5. To familiarize with few types of Probability distributions, correlation and regression.

Prerequisites	Basic knowledge in calculus, algebra, statistics and trigonometry

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Differentiation of standard functions - Angle of intersection of curves in Cartesian and polar coordinates - Partial differentiation - Maxima and minima of functions of two variables.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Binomial, exponential and logarithmic series (no proof) - Expansions and application to summation.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Integration -Methods of integration - Integration of rational and irrational functions - Integration by parts - Bernoulli's Formula- Reduction Formula - Definite integrals - Properties of definite integrals.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

IV	De Moivre's theorem and applications - Expansions of $\sin n\theta$, $\cos n\theta$, $\sin^n \theta$, $\cos^n \theta$, $\sin \theta$, $\cos \theta$	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Probability - Mean -Standard deviation- Correlation - Rank Correlation - Regression - Binomial, Poisson and Normal distributions.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Book

1. Calculus, Vol. I, Narayanan, S. and Manicavachagom Pillay, T.K, S. Viswanathan Printers & Publishers, 1996.
   Unit I: Chapter 2 - Sections: 1, 2.1 - 2.6, 3.1, 3.2, 3.3
   Chapter 4 - Sections: 4, 4.1
   Chapter 9 - Sections: 1.4, 4.1 - 4.6
2. Algebra, Manicavachagom Pillay, T.K, Natarajan T., and Ganapathy K. S., Viswanathan Printers & Publishers, 1994.
   Unit II: Chapter 3 - Sections: 1 (except problems), 10
   Chapter 4 - Sections: 3, 4, 5, 6, 7
3. Calculus, Vol. II, Narayanan, S. and Manicavachagom Pillay, T.K, S. Viswanathan Printers & Publishers.
   Unit III: Chapter 1 - Sections: 1.1, 1.2, 2, 3, 4, 5, 6.1 - 6.6, 7.1 - 7.5, 8, 9, 10, 11, 12, 13, 13.1 - 13.10, 14, 15.1, 15.2
4. Trigonometry, Narayanan, S. and Manicavachagom Pillay, T.K, S. Viswanathan Printers & Publishers, 2012.
   Unit IV: Chapter 2 - Sections: 2, 3, Chapter 3 - Sections: 1, 2, 3, 4, 4.1, 5, 5.1
5. Fundamentals of Mathematical Statistics, S. P. Gupta., V.K. Kapoor, Sultan Chand and sons Publishers, 2002.
   Unit V: Chapter 2 - Sections: 2.5, 2.13.4
   Chapter-10 - Sections: 10.1, 10.2, 10.3, 10.4, 10.4.2, 10.7, 10.7.1, 10.7.2, 10.7.3
   Chapter-11: Sections: 11.1, 11.2, 11.2.1, 11.2.5
   Chapter-8: Sections: 8.4, 8.5, 8.5.9
   Chapter-9: Sections: 9.1, 9.2, 9.2.14

Suggested Reading

1. Probability: A Graduate Course Allan Gut, Springer, 2012, 2nd Edition.
2. Vector Analysis, Duraipandian. P, Emerald Publishers, 1984.
3. Mathematics in Chemistry - An Introduction to Modern Methods, Harry G. Hecht, Pearson College Div,1990, First Edition.
4. Allied Mathematics Vol I, P. Kandasamy, K. Thilagavathy, S Chand, 2014, Vol I, ebook.
5. Allied Mathematics Vol II, P. Kandasamy, K. Thilagavathy, S Chand, 2014, Vol II, eBook.
6. Differential Calculus, Shanthi Narayanan, Chand & Co, 1964.
7. Trigonometry Vittal P. R., Margham Publications, 1988.
8. Engineering Mathematics, Venkataraman, M.K, The National Publishing Co, 2001, Second Edition.

Web Resources

1. https://www.khanacademy.org/math/differential-calculus
2. http://www.calculus.org/
3. https://www.brightstorm.com/math/trigonometry/
4. https://www.tutor.com/subjects/trigonometry
5. https://www.shmoop.com/probability-statistics/resources.html

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand and recall concepts in calculus, trigonometry and statistics	K1, K2
CO2	To apply the appropriate mathematical and statistical techniques in different areas of chemistry.	K3
CO3	To determine the angle of intersection of curves, relationship between two statistical data and relationship between the trigonometric functions.	K4
CO4	To evaluate integrals, maxima and minima of a function and higher order trigonometric function using appropriate methods.	K5
CO5	To formulate and solve problems in chemistry using techniques of calculus, trigonometry and probability theory.	K6

Course Code	UMT 1303
Course Title	Mathematics for Statistics - I
Credits	3
Hours/Week	6
Category	Allied Required (AR) - Theory
Semester	I
Regulation	2019

Course Overview

1. Differentiation and integration are the two major concepts of calculus which are used to study the change of functions.
2. The main aim is to provide the mathematical foundation for statistics.
3. It deals with the introduction and problems on differentiation and integration.
4. Successive differentiation, meaning of the derivative and partial differentiation are discussed.
5. This course provides various techniques to evaluate integrals.

Course Objectives

1. To understand the mathematical concepts in calculus.
2. To improve problem-solving and analytical skills in differentiation and integration.
3. To analyze functions using derivatives and integrals.
4. To familiarize with the properties of differentiation and integration.
5. To apply the appropriate techniques in calculus to solve statistical problems.

Prerequisites	Basic knowledge in differentiation and integration

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Differentiation: Differentiation of functions - Product Rule - Quotient Rule - Function of function (exclude hyperbolic function)- Logarithmic differentiation - Implicit functions - Differentiation of one function with respect to another function.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Successive differentiation: Leibnitz theorem (statement only) and simple problems - Meaning of the derivative - Maxima and Minima of functions of one variable (exclude rate of change, acceleration, velocity) - Concavity and Convexity, points of inflexion.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	Partial Differentiation: Function of function rule - Homogeneous functions - Euler's theorem - Maxima and Minima of functions of two variables.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Integration: Methods of Integration - Integration of rational algebraic functions - Integration of irrational functions - simple problems.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Definite Integration: Properties of definite integrals - integration by parts (exclude inverse function) - reduction formula.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Narayanan, S. and Manickavachagam Pillai, T.K., Calculus Vol I, S. Viswanathan Printers & Publishers, 2007.
   Unit 1: Chapter 2 - Sections: 1, 2.1 - 2.6, 3.1 - 3.8, 4.1,4.2, 5, 7.
   Unit 2: Chapter 3 - Sections: 1.1 - 1.4, 2.1, 2.2, Chapter 4 - Section: 2.2
   Chapter 5 - Sections: 1.1 - 1.5, 2
   Unit 3: Chapter 8 - Sections: 1.1, 1.2, 1.6, 4, 4.1
2. Narayanan, S. and Manickavachagam Pillai, T. K., Calculus Vol II, S. Viswanathan Printers & Publishers, 2012.
   Unit 4: Chapter 1 - Sections: 2 - 3, 5, 6.2 - 6.6, 7.1, 7.3, 7.4, 8 (case i & ii).
   Unit 5: Chapter 1 - Sections: 4, 11, 12, 13.1 - 13.6

Suggested Readings

1. Narayanan, S. and Manickavachagam Pillai, T. K., Ancillary Mathematics Vol - I, Viswanathan Printers & Publishers, 2007.
2. Vittal, P. R, Allied Mathematics, Margham Publications, 2015.
3. Singaravelu, A., Allied Mathematics, A.R.S. Publications, 2014.
4. P. Kandasamy, K. Thilagavathy, Allied Mathematics, Tata McGraw - H S Chand ill, 2014.

Web Resources

1. https://www.youtube.com/watch?v=-OITIc9HeUQ
2. https://mathinsight.org/integration_applications
3. https://ocw.mit.edu/ans7870/resources/Strang/Edited/Calculus/Calculus.pdf
4. https://www.sac.edu/FacultyStaff/HomePages/MajidKashi/PDF/MATH_150/Bus_Calculus.pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand and recall the basic concepts of calculus and its applications.	K1, K2
CO2	To acquire knowledge in differentiation and integration and solve related problems.	K3
CO3	To develop competency in applying the ideas of derivatives, partial derivatives and integration.	K4
CO4	To evaluate integrals and application problems on differentiation.	K5
CO5	To derive the maxima and minima for algebraic functions and solutions for integration with appropriate techniques.	K6

Course Code	UMT 3401
Course Title	Mathematics for Chemistry - II
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	III
Regulation	2019

Course Overview

1. This course discusses some mathematical concepts and their applications in the field of chemical sciences.
2. Multiple integrals and beta and gamma functions are studied.
3. Various types of differential equations and Laplace transforms are discussed.
4. Numerical methods are used to solve problems related to chemistry.
5. The fundamental concepts of group theory are discussed.

Course Objectives

1. To introduce and evaluate multiple integrals.
2. To acquire knowledge of ordinary and partial differential equations and use suitable methods for solving them.
3. To introduce Laplace transform and apply it for solving certain differential equations.
4. To utilize numerical methods in solving a system of linear equations and estimating roots of functions.
5. To impart the knowledge of group theory to realize some concepts of chemical sciences.

Prerequisites	Basic knowledge in fundamental mathematics and calculus.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Change of order of integration-change of variables - Jacobian - Double and triple integrals in Cartesian and polar coordinates - Beta and Gamma integrals and their properties	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Ordinary differential equations - Solutions of first order and first-degree equations - Exact equations Mdx + Ndy = 0 - Second order differential equations with constant coefficients - Partial differential equations (standard types)	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Laplace transform of elementary functions and periodic functions - Inverse transform - Application to differential equations.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Solutions to simultaneous linear equations - Gauss elimination - Gauss Seidal iterative method - successive bisection - Newton-Raphson method - Interpolation - Newton's interpolation formulae - Problems related to applications in chemistry.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Group - Abelian and non-abelian group - Cayley's table - subgroup - cyclic group - cosets and Lagrange's theorem - Normal subgroups - definition and simple problems only (no proofs for theorems)	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Calculus Volume II, Narayanan S, and Manickavachagam Pillai T. K, S. Viswanathan Printers & Publishers, 1996.
   Unit 1: Chapter 5 - Sections: 2.1, 2.2, 3.1, 3.2, 4, 6.1, 6.2, 7
   Chapter 6 - Sections: 1.1, 1.2, 2.1, 2.2, 2.3, 2.4
   Chapter 7 - Sections: 2.1, 2.2, 2.3, 3, 4, 5
2. Calculus Volume III, Narayanan S, and Manickavachagam Pillai T. K, S. Viswanathan Printers & Publishers, 1996.
   Unit 2: Chapter 1 - Sections: 1.1, 1.2, 2.1, 2.4, 2.5, 3.1, 3.2, 3.3
   Chapter 2 - Sections: 1.1, 1.2, 2, 3, 4
   Chapter 4 - Sections: 1, 3, 4, 5.1, 5.2, 5.3, 5.4
   Unit 3: Chapter 6 - Sections: 1.1, 1.2, 2, 3, 4, 6, 7, 8
3. Numerical Methods, Vedamurthy V.N, Iyengar, Vikas Publishing House, 1998.
   Unit 4: Chapter 3 - Section 3.2, 3.5
   Chapter 4 - Sections: 4.1, 4.2, 4.10
   Chapter 6 - Sections: 6.1, 6.2, 6.3
4. Modern Algebra, Santiago M. L, Arul Publications, 1988.
   Unit 5: Chapter 2 - Sections: 2.1, 2.2, 2.4, 2.5, 2.6, 2.7

Suggested Readings

1. Text book of Multiple Integrals, A. K. Sharma, Discovery Publication Houe, 2005.
2. Engineering Mathematics, III-A, Venkataraman M.K, The National Publishing Co., First Edition, 1995.
3. Allied Mathematics Vol II, P. Kandasamy, K. Thilagavathy, S Chand & Co., 2014.
4. Numerical Methods, Babu Ram, Pearson Publishing, First Edition, 2010.
5. Abstract Algebra, Dipak Chatterjee, PHI Learning, Third Edition, 2015.
6. Mathematics in Chemistry - An Introduction to Modern Methods, Harry G. Hecht, Pearson College Div., First Edition, 1990.
7. Physical Chemistry - A Molecular Approach, Donald A. Mcquaire and John D. Simon, University Science Books, Sausalito, California, First Edition, 1997.
8. Numerical Methods for Engineers, D. Vaughan Griffiths, I. M. Smith, Chapman & Hall CRC, Second Edition, 2006.
9. Numerical Methods in Science and Engineering, Venkataraman M.K, The National Publishing Co., Third Edition, 1995.

Web Resources

1. https://ocw.mit.edu/ans7870/textbooks/Strang/Edited/Calculus/14.pdf
2. https://people.utm.my/zuhaila/files/2016/03/LectureNoteChap1DE.pdf
3. https://bit.ly/3v6AvRF
4. https://bit.ly/2YGBJqX
5. https://www.msuniv.ac.in/Download/Pdf/f3604e30dc894e2
6. https://sam.nitk.ac.in/courses/MA608/solution%20of%20linear%20system.pdf
7. http://mpbou.edu.in/slm/mscche1p4.pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the concepts of multiple integrals, differential equations, Laplace transforms, numerical methods and group theory.	K1, K2
CO2	To apply techniques of multiple integrals, differential equations, Laplace transforms, numerical methods and group theory in solving related problems.	K3
CO3	To analyze the concepts of multiple integrals, differential equations, Laplace transforms, numerical methods and group theory.	K4
CO4	To evaluate multiple integrals, differential equations, Laplace transforms, numerical methods and group theory.	K5
CO5	To facilitate applications of mathematics in the stream of chemical sciences.	K6

Course Code	UMT 3801
Course Title	Mathematics for Competitive Examinations
Credits	2
Hours/Week	3
Category	Non-Major Elective (NME) - Theory
Semester	III
Regulation	2019

Course Overview

1. This course deals with quantitative aptitude which is an inseparable and an integral part in career development.
2. The different types of relationships and the rules to govern them are studied.
3. Problems based on different aspects of the physical world such as space, time and quantity are solved.
4. Business related concepts like gain, loss, simple and compound interests are discussed.
5. Combinatorial and geometrical problems are explained.

Course Objectives

1. To develop analytical and logical skills.
2. To use appropriate formulas and methods for a given situation.
3. To acquire simple techniques for dealing quantities, business transactions, data analytics and geometrical structures.
4. To relate and solve problems based on equations.
5. To manage the crisis of time in aptitude tests.

Prerequisites	Fundamentals of elementary mathematics.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Numbers: Number system - Sequences & Series - H.C.F. & L.C.M - Decimal & Fraction - Simplification.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Arithmetic: Averages - Ratio & Proportion - Percentage - Profit & Loss - Simple Interest & Compound Interest - Time, Speed & Distance -Time & Work.	6	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Algebra: Quadratic equations - Inequalities - Logarithm - Basic algebraic identities of School Algebra & Surds.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Mensuration: Right Circular Cone - Cylinder - Right Circular cylinder - Sphere - Pyramid.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Modern Maths: Data Interpretation: Frequency Polygon - Histogram - Pie-Chart - Bar Diagram - Permutation and Combination - Probability.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publications, Fourth edition,2018.
   Unit 1: Chapters - 1, 2, 3, 4
   Unit 2: Chapters - 10, 11, 12, 14, 15, 17, 22, 25
   Unit-3: Chapters - 6, 7, 31
   Unit 4: Chapter - 35
   Unit 5: Chapters - 32, 33, 41, 42, 43, 44
2. Quantitative Aptitude for Competitive Examinations, RS Aggarwal, S Chand Publishing, Revised edition, 2017.

Suggested Readings

1. Objective Arithmetic (SSC and Railway Exam Special), RS Aggarwal, S Chand Publishing,2nd edition, 2018.
2. Quantitative Aptitude Quantum CAT 2019, Sarvesh K Verma, Arihant Publications, 10thedition, 2019.
3. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha, McGraw Hill Education, Sixth edition, 2016.

Web Resources

1. www.indiabix.com
2. www.testpot.com
3. www.freedu.in
4. www.sawaal.com
5. www.careerbless.com

6. http://testbook.com
7. www.faceprep.in

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the number system, algebraic operations, dataset and geometrical shapes.	K1, K2
CO2	To practice the problems based on the numerical quantities.	K3
CO3	To determine the solutions of physical, financial, statistical and geometrical related problems.	K4
CO4	To evaluate the characteristics of quantitative and geometrical dataset.	K5
CO5	To formulate the mathematical relationships for real-life problems and obtain the suitable alternatives.	K6

Course Code	UMT 4401
Course Title	Mathematics For Commerce
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

1. Calculation of profit and loss, rates of interest and discount in business are discussed in this course.
2. Enhancement of mathematical logics and reasoning is imparted.
3. The optimization of costs and revenue in business is studied in this course.
4. Computational skills and applications in commerce are carried out through definite integrals.
5. This course also helps to use Boolean parameters to design logic circuits.

Course Objectives

1. To understand the concepts related to financial mathematics such as rates of interest and discount.
2. To learn conditional statements and make use of logical connectives.
3. To analyze and apply the concepts of differentiation in commerce.
4. To apply the techniques of integration in business and to interpret.
5. To know Boolean parameters in constructing truth tables and logic circuits.

Prerequisites	Basic knowledge of financial mathematics, integration and differentiation.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Nominal rate of Interest and effective rate of interest - Continuous Compounding - Force of interest - Compound interest calculations at varying rate of interest - Present value, interest and discount - Nominal rate of discount - Effective rate of discount - Force of discount - Depreciation.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Mathematical Reasoning - Mathematical statement - Negation of a statement - Simple and Compound statements - Connectives - Implications - Contra positive and Converse statement - Conditional statements - antecedent - consequent - Quantifiers - Contradiction.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	Functions - Equilibrium - Elasticity - Relation between Average and Marginal Cost Curves - Simple problems	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Definite integration - Properties - Applications of Integrations: Finding different types of functions in simple cases - Consumers' and producers' surplus - Nature of commodities - Learning Curve - Rate of Sales - Amount of Annuity	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Basic Properties - Derived Properties - Boolean Functions - Canonical Form - Electrical Switching System - Boolean Multiplication - Boolean Addition - Circuits with Composite Operations - Simple problems.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Business Mathematics and Statistics, B M Agarwal, Vikas Publishing House, New Delhi, Fourth Edition, 2009.
   Unit 1: Chapter 8 - Sections: 8.1, 8.2, 8.3, 8.4. 8.5, 8.6, 8.7, 8.9
2. Discrete Mathematics, An Open Introduction, Oscar Levin, Third Edition, 2013-2021.
   Unit 2: Section: 0.2 (4 - 23)
3. Business Mathematics, D.C. Sancheti, V.K. Kapoor, Sultan Chand & Sons (P) Ltd, Eleventh Thoroughly Revised Edition, 2004.
   Unit 3: ACE 5 - ACE 45, Practice Problems: ACE 45 - ACE 90
   (Only Simple and application-oriented problems have to be worked out)
   Unit 4: Chapter 18 - Sections: 18.10, 18.11 (Simple problems), ACE 90 - ACE 112
   Unit 5: Chapter 3 - Sections 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8

Suggested Readings

1. Business Math: A step by step Handbook, J. Oliver, 2021 (e-Book).
2. Boolean Functions Theory, Algorithms, and Applications, YVES Crama, Peter L. Hammer, Cambridge university press, 2011.
3. Calculus and its applications, M.L. Bittinger, D. J. Ellenbogen, S. A. Surgent, Pearson Education 2012.
4. Discrete Mathematical Structures with applications to Computer science, J. P. Trembley, R. Manohar, McGrew Hill Book Co., second edition, 2001.

Web Resources

1. https://www.youtube.com/watch?v=JQBRzsPhw2w
2. https://lila1.lyryx.com/textbooks/OLIVIER_1/marketing/Olivier-BusinessMath-2021A.pdf
3. https://www.youtube.com/watch?v=OjWmVCG8PLA
4. https://www.youtube.com/watch?v=U7Asqs-XENk

5. https://staff.agu.edu.vn/ltduy/files/2012/10/Applications-of-Calculus-in-economics.pdf
6. https://mysmu.edu/faculty/yktse/FMA/S_FMA_1.pdf
7. https://www.actexmadriver.com/samples/BPP-02.P.CN.08F%20sample%206-4-08.pdf
8. https://www.pstat.ucsb.edu/sites/secure.lsit.ucsb.edu.stat.d7/files/sitefiles/Resources/Actuary/mainf.pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To recall the fundamental mathematical concepts and to identity them in business environment.	K1, K2
CO2	To apply mathematical concepts to solve problems related to business.	K3
CO3	To investigate the optimal solutions of problems related to commerce using differentiation, integration, mathematical logics and some financial tools.	K4
CO4	To evaluate the knowledge in calculus and Boolean algebra in order to solve business-oriented problems.	K5
CO5	To develop a business by using the ideas of differentiation, integration, mathematical logics and financial tools.	K6

Course Code	UMT 4402
Course Title	Mathematics for Physics - II
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

1. This course comprising of Fourier series, differential equations, Laplace transforms and vector calculus has numerous applications in physics.
2. It deals with the study of Fourier series.
3. The concept of differential equations and methods of finding solutions are studied in detail.
4. Laplace transforms and its applications in solving differential equations are discussed.
5. This course introduces vector calculus and also deliberates the concepts of line, surface and volume integrals.

Course Objectives

1. To appreciate the concept of Fourier series in expressing certain functions as an infinite series.
2. To understand and solve various types of first order differential equations.
3. To learn the different methodologies in finding the solutions of second order differential equations.
4. To apply Laplace transforms to solve differential equations.
5. To realize the concept of vector differentiation and integration in evaluating the problems.

Prerequisites	Fundamentals in calculus.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Introduction - Euler's formula - Condition for a Fourier expansion - Functions having point of discontinuity - Change of interval- Even and odd function - Expansion of even or odd periodic functions - Half range series	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Definition - practical approach to differential equations -Formation of differential equation - Solution of a differential equation- Geometrical meaning of a differential equation - Equations of the	11	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

	first order and first degree- Variables separable- homogeneous equations - Equations reducible to homogeneous form - Linear equations - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Equations of first order and higher degree - Clairut's equation.		CO4 CO5	
III	Definitions - Complete solution - Operator D - Rules for finding complementary function - Inverse operator- Rules for finding the particular integral - Working procedure to solve the equation - Other methods for finding particular integral (Method of variation of parameters and Method of undetermined coefficients)	11	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Introduction - Definition - conditions for existence - transform of elementary functions - properties of Laplace transform - Transform of periodic function- Transform of special functions - Transform of derivatives- Transform of integrals - Multiplication by tn - Division by t - Evaluation of integrals by Laplace transforms - Inverse Transforms-Method of partial fractions - Other methods of finding inverse transforms - Convolution theorem - Application to differential equations.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Differentiation of vectors- Curves in space - Velocity and acceleration - Scalar and vector point functions - Gradient- Divergence - Physical interpretation of divergence - Integration of vectors - Line integral - Surfaces - Green's theorem in the plane - Stroke's theorem (Statement and problems only) - Volume integral - Gauss divergence theorem (Statement and problems only)- Irrotational and solenoidal fields	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

Higher Engineering Mathematics, Dr. B. S. Grewal, Khana Publications, 42nd Edition, 1996.

Unit 1: Chapter 10 - Sections: 10.1 - 10.7
Unit 2: Chapter 11 - Sections: 11.1 - 11.14
Unit 3: Chapter 13 - Sections: 13.1 - 13.8
Unit 4: Chapter 21 - Sections: 21.1 - 21.15
Unit 5: Chapter 8 - Sections: 8.1 - 8.16, 8.18

Suggested Readings

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & sons, 10th Edition, 2011.
2. Allied Mathematics, S P Rajagopalan, R Sattanathan, Vijay Nicole imprints Pvt.Ltd., 2007.
3. Differential Equations and Laplace Transforms, A. Singaravelu, ARS publications, 2015.

Web Resources

1. www.mathworld.wolfram.com

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the basic concepts of Fourier Series, differential equations, Laplace transforms and vector calculus.	K1, K2
CO2	To acquire the knowledge of various mathematical methods in solving the problems.	K3
CO3	To analyze Fourier series expansion of certain functions, appropriate method to find the solution of differential equations and the results in vector calculus.	K4
CO4	To assess the techniques in Fourier Series, differential equations, Laplace transforms and vector calculus for solving real life problems.	K5
CO5	To construct infinite series for certain functions in terms of sines, cosines and to form and analyze the differential equations of first and second orders.	K6

Course Code	UMT 4403
Course Title	Mathematics For Statistics - II
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

1. This course is designed to study the concepts of real analysis to apply in statistics.
2. It deals with basic theoretical knowledge of sequences and series.
3. It helps to understand the notion of limit and continuity of a real function.
4. A detailed study of derivatives and its applications are discussed.
5. The concept of Riemann-integral and its properties are studied.

Course Objectives

1. To demonstrate an understanding the convergence of sequence and series.
2. To analyze various tests for convergence of series.
3. To develop the concept of continuity of real valued functions.
4. To study the concept of differentiation and its application.
5. To familiarize with the notion of Riemann-integral and its properties.

Prerequisites	Basic knowledge in sets and functions

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Sets and elements: Operations on sets - least upper bounds - Sequence of real numbers -Definition of sequence and sub sequence - Limit of a sequence - Convergent sequence - Bounded sequence - Monotone sequence - Operations on convergent sequence.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Series: Series of real numbers - Convergence and divergence - Series with non-negative terms - Alternating series - Conditional convergence and absolute convergence - Tests for absolute convergence.	16	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

			CO4 CO5	
III	Limits: Limit of a function on the real line - Non decreasing and non-increasing functions - Monotone function - Strictly increasing and strictly decreasing functions - Functions continuous at a point on the real line - Discontinuous functions on the real line - nowhere dense set.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Differentiation: Derivatives - Rolle's Theorem - The law of the mean - Fundamental theorems of calculus - Taylor's theorem - The binomial theorem.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Riemann Integration: Sets of measure zero - Definition of Riemann integral - Upper and Lower sums - Upper and Lower integral - Existence of Riemann Integral - Properties of Riemann Integral - Improper integrals.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Methods of Real Analysis, Goldberg, R.R., Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, 2020, Reprint.
   Unit 1: Chapter 1 - Sections: 1.1, 1.2, 1.7; Chapter 2 - Sections: 2.1 - 2.3, 2.5 - 2.7
   Unit 2: Chapter 3 - Sections: 3.1 - 3.4, 3.6
   Unit 3: Chapter 4 - Section: 4.1, Chapter 5: Sections: 5.1, 5.6
   Unit 4: Chapter 7 - Sections: 7.5 - 7.8, Chapter 8: Sections: 8.5, 8.6
   Unit 5: Chapter 7 - Sections: 7.1 - 7.4, 7.9, 7.10

Suggested Readings

1. Mathematical Analysis, Apostol, T.M., Narosa Publications, 2nd edition, 1996.
2. Introduction to Real Analysis, Bartle, R.G., & Shebert, Wiley Eastern & Sons, 1982.
3. Real Analysis, K. Viswanatha Naik, Emerald Publishers, First Edition.

Web Resources

1. https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/Real-Analysis-4th-Ed-Royden.pdf
2. https://www.math.stonybrook.edu/~aknapp/download/b2-realanal-inside.pdf
3. https://math.unm.edu/~crisp/courses/math401/tao.pdf
4. https://www.jirka.org/ra/realanal.pdf
5. https://www.topfreebooks.org/tag/real-analysis/
6. https://libribook.com/ebook/14009/how-think-analysis-pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the concepts of sequences, series, continuity, differentiation and integration.	K1, K2
CO2	To solve problems using several results and techniques.	K3
CO3	To investigate the structure and properties in sequences, series, continuity, differentiation and integration.	K4
CO4	To estimate convergence of sequences and series, continuity, differentiation and integration.	K5
CO5	To explain the concepts of convergence of sequences and series, continuity, differentiation and integration.	K6

Course Code	UMT 4404
Course Title	Advanced Mathematics for Economics
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

2. Mathematics is used as a tool for presenting, manipulating, exploring economic models by the economists.
3. Economic models can be constructed by using mathematical techniques and predictions about the future economic activities can be done.
4. Concepts of Calculus, Differential Equations and Difference Equation are used to measure economic parameters.
5. In this course some optimization problems in economics are discussed.
6. A spreadsheet to plot the time path of dependent variables in economic models is constructed.

Course Objectives

1. To find the firm's profit -maximizing output using calculus concepts.
2. To solve unconstrained & constrained optimization problems and resource allocation problems in economics.
3. To formulate and solve linear first-order difference equations.
4. To use exponential and logarithms functions to derive the growth rate of investment.
5. To use differential equation for predicting values in basic market and macroeconomic models.

Prerequisites	Basic algebra and calculus

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Unconstrained optimization-First-order conditions for a maximum - Second-order condition for a maximum - Second-order condition for a minimum - Summary of second-order conditions - Profit maximization -Inventory control - Comparative static effects of taxes.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Constrained optimization and resource allocation - Constrained optimization by substitution -The Lagrange multiplier: constrained maximization with two variables - The Lagrange multiplier: second-order conditions - Constrained minimization using the Lagrange multiplier - Constrained optimization with more than two variables.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Dynamic economic analysis - The cobweb: iterative solutions - The cobweb: difference equation solutions - The lagged Keynesian macroeconomic model - Duopoly price adjustment.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Continuous growth and the exponential function - Accumulated final values after continuous growth - Continuous growth rates and initial amounts - Natural logarithms - Differentiation of logarithmic functions.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Continuous time and differential equations - Solution of homogeneous differential equations - Solution of non-homogeneous differential equations - Continuous adjustment of market price - Continuous adjustment in a Keynesian macroeconomic model.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Book

Basic Mathematics for Economics, Mike Rosser, Routledge London, NY, Second Edition, 2003.

Unit I: Chapter 9 - Sections: 9.1 to 9.7
Unit II: Chapter 11 - Sections :11.1 to 11.6
Unit III: Chapter 13 - Sections: 13.1 to 13.5
Unit IV: Chapter 14 - Sections: 14.1 to 14.5
Unit V: Chapter 14 - Sections: 14.6 to 14.10

Suggested Reading

Theory and problems of Introduction to Mathematical Economics, Edward D. Dowling, Ph. D, Schaum's outline series, McGraw Hill, 2001.

Web Resources

1. http://www.neusser.ch/downloads/DifferenceEquations.pdf
2. http://www.studyingeconomics.ac.uk/tips-for-working-efficiently/maths-help/

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand some mathematical concepts used in economics.	K1, K2
CO2	To apply the concepts of calculus, differential equations and difference equations in various economic problems.	K3
CO3	To analyze unconstrained & constrained optimization problems and dynamic and macroeconomic models.	K4
CO4	To compare and contrast discrete and continuous growth rate in investment and evaluate the economic problems.	K5
CO5	To formulate and apply the concepts to develop new economic models	K6

Course Code	UMT 4405
Course Title	Mathematics for Computer Applications
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

1. This course helps to impart the basic knowledge of mathematics in computer science.
2. It aims to cover mathematical areas such as trigonometry, theory of equations, partial differential equation, matrices and numerical methods.
3. The significances of trigonometry and the theory of equations are discussed.
4. Finding approximation solutions for polynomial equations are studied.
5. It provides knowledge on matrices and partial differential equations.

Course Objectives

1. To study series expansion of sine and cosine functions and hyperbolic functions.
2. To discuss the theory of equations.
3. To utilize the concepts of Eigen values and Eigen vectors in computer applications.
4. To find the solutions of partial differential equations.
5. To obtain approximate solutions of algebraic and transcendental equations.

Prerequisites	Basic knowledge in differentiation, trigonometry, and functions.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Trigonometry: Expansions of $\sin nx$, $\cos nx$,$\tan nx$ - powers of sines and cosines of x in terms of functions of multiples of x - hyperbolic functions, relation between hyperbolic and circular functions.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Theory of Equations: Equations - roots of equations - equations with irrational or complex roots - relation between roots and coefficients - transformation of equations - reciprocal equations.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	Matrices: Symmetric, skew symmetric, Hermitian, skew Hermitian, orthogonal, unitary matrices - rank and consistency of equations - eigen values, eigen vectors, Cayley-Hamilton theorem (without proof).	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Partial Differentiation: Variables - dependent and independent variables - partial derivatives of functions of two variables - Euler's theorem on homogeneous functions (without proof).	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Numerical Methods: Solutions of algebraic and transcendental equations using Regula-Falsi method, Newton Raphson's method - numerical differentiation - numerical integration using trapezoidal, Simpson's rules.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Trigonometry, S. Narayanan, T. K. Manickavachagom Pillai, S. Viswanathan Printers & Publishers 2006.
   Unit I: Chapter 3 - Sections: 1, 2, 3, 4, 4.1, 5, 5.1, Chapter 4 - Sections: 1, 2, 2.1 - 2.3
2. Algebra Vol. 1 T. K. Manickavachagom Pillai, T. K. Natarajan, K. S. Ganapathy S. Viswanathan Printers & Publishers, 2015.
   Unit II: Chapter 6 - Sections: 1 - 11, 15, 15.1 - 15.3, 16, 16.1, 16.2
3. Algebra Vol. 2 T. K. Manickavachagom Pillai, T. K. Natarajan, K. S. Ganapathy S. Viswanathan Printers & Publishers, 2015.
   Unit III: Chapter 2 - Sections: 1, 1.1, 6.1 - 6.3, 9.1, 9.2, 11, 13, 13.1, 14, 14.1, 14.2, 16, 16.1 - 16.4
4. Calculus Vol. 1 S. Narayanan, T. K. Manickavachagom Pillai, S. Viswanathan Printers & Publishers, 1996.
   Unit IV: Chapter 8 - Sections: 1.1, 1.2, 1.6, 1.7
5. Numerical Methods in Science and Engineering, M. K. Venkataraman, The National Publishing Company, Chennai, 1999.
   Unit V: Chapter 3 - Sections: 1, 4, 5, Chapter-9 Section 1, 2, 3, 7, 8, 9

Suggested Reading

1. Allied Mathematics, A. Singaravelu, ARS Publications, 2011.

Web Resources

1. https://www.coursera.org/learn/differential-equations-engineers
2. https://www.coursera.org/learn/intro-to-numerical-analysis#syllabus
3. https://bit.ly/3v7QfnF
4. https://www.khanacademy.org/math/trigonometry

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the fundamentals of trigonometry, matrices, theory of equations, partial differential equations and numerical methods.	K1, K2
CO2	To employ appropriate mathematical techniques in solving problems.	K3
CO3	To analyze the applications of trigonometry, matrices, theory of equations and numerical methods.	K4
CO4	To evaluate partial differential equations, roots of an equation and the characteristic values of matrices.	K5
CO5	To formulate and solve problems in the field of computer science using various techniques of trigonometry, matrices, algebra and numerical methods.	K6

Course Code	UMT 4406
Course Title	Mathematics for Computer Science
Credits	3
Hours/Week	5
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

1. The aim of this course is to provide the mathematical foundation for Computer Science.
2. This course deals with matrices, determinants, eigen values and eigen vectors.
3. The basic concepts of vector calculus and their applications are discussed.
4. This course briefs concept of differentiation and integral calculus.
5. The solutions of ordinary and partial differential equations are dealt with.

Course Objectives

1. To understand the concepts of linear algebra.
2. To recall the concepts of matrices and solve the system of equations.
3. To develop the skill of solving ordinary and partial differential equations.
4. To comprehend the applications of various techniques of vector calculus.
5. To study line, surface and volume integrals in vector calculus.

Prerequisites	Basic knowledge in algebra, calculus and vectors.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Linear Algebra: Matrices - Determinants - System of linear equations - Eigen values and Eigen vectors - LU decomposition.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	Calculus: Differentiation: Limits - Continuity - Differentiability - Maxima and Minima (Two variables only) - Mean value theorem. Integration: Evaluation of Definite Integrals - Bernoulli's formula - Evaluation of double integrals and triple integrals.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	Vector Calculus: Gradient, Divergence, Curl - Directional derivative - Irrotational and Solenoidal vector fields - Green's theorem, Gauss Divergence - Stoke's theorem (excluding proofs) - Simple applications.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Ordinary Differential Equations: Solving the second order differential equations - Particular integral for and polynomial - Second order differential equations with variable coefficients - homogeneous functions.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Partial Differential Equations: Complete Integral - General Integral - Standard types - Lagrange's equation.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Algebra Volume 2, by T. K. Manickavachagom Pillai, T. K. Natarajan and K.S. Ganapthy, S. Viswanathan Printers and Publishers, 2017.
   Unit 1: Chapter 2 - Sections: 1 - 8, 14, 15, 16.
2. Calculus Volume 1, by S. Narayanan and T. K. Manickavachagam Pillai, S. Viswanathan Printers and Publishers, 2017.
   Unit 2: Chapter 1 - Sections: 5 - 12
   Chapter 2 - Sections: 1, 2, 3.1 - 3.8 (Except Trigonometry)
   Chapter 5 - Section 1
   Chapter 6 - section 2
3. Calculus Volume 2, by S. Narayanan and T. K. Manickavachagam Pillai, S. Viswanathan Printers and Publishers, 2017.
   Unit 2: Chapter 1 - Section 15.1
   Chapter 5 - Sections: 1, 2, 4
4. Vector Analysis, by Duraipandian P, Laxmi Duraipandian, Emerald Publishers and Distributors, 1998.
   Unit 3: Chapter 2 - Sections: 2.1 - 2.6, 2.9
   Chapter 4 - Sections: 4.1, 4.2, 4.4, 4.5, 4.8
5. Calculus Volume 3, by S. Narayanan and T. K. Manickavachagam Pillai, S. Viswanathan Printers and Publishers, 2017.
   Unit 4: Chapter 2 - Sections: 1, 2, 3, 4a, 4c
   Chapter 2 - Sections: 2, 8, 9
   Unit 5: Chapter 4 - Sections: 1 - 6

Suggested Readings

1. A Text Book of Vector Analysis, by Shanti Narayan, P. K. Mittal, S. Chand Publishers, 19th Edition, 2013.
2. Allied Mathematics, by P. R. Vittal, Margham publications, 2005.

3. Allied Mathematics, by Singaravelu, A, A.R.S. Publications, 2014.

Web Resources

1. https://bit.ly/3awdjmr
2. https://www.chebfun.org/examples/approx3/GaussGreenStokes.html
3. https://mathworld.wolfram.com/OrdinaryDifferentialEquation.html
4. https://www.math.uni-leipzig.de/~miersemann/pdebook.pdf
5. https://www.khanacademy.org/math
6. https://www.geeksforgeeks.org/l-u-decomposition-system-linear-equations/

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To understand the various concepts of matrices, vector calculus, ordinary and partial differential equations.	K1, K2
CO2	To apply the theory of matrices, ordinary and partial differential equations and calculus for solving related problems.	K3
CO3	To analyze the concepts of linear algebra, calculus, vector calculus, ordinary and partial differential equations.	K4
CO4	To determine the impact of mathematical concepts in computer science using linear algebra, calculus and vectors.	K5
CO5	To create mathematical tools and models used in computer science.	K6

Course Code	UMT 4801
Course Title	Popular Astronomy
Credits	2
Hours/Week	3
Category	Non-Major Elective (NME) - Theory
Semester	IV
Regulation	2019

Course Overview

1. The course aims to popularize and introduce astronomy.
2. The course deals with the connectivity of astronomy with day today life.
3. To Familiarize the bonding of religion and astronomy.
4. The course provides the significance of astronomical events.
5. To exercise the handling of Telescopes.

Course Objectives

1. To understand the reasons for celestial events.
2. To have a clear knowledge about religion and astronomy.
3. To emphasis on the formation of universe.
4. To catalog star categories.
5. To demonstrate star maps and knowledge about telescope.

Prerequisites	Basic knowledge in space science with passion.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive level
I	Introduction to Astronomy: Origin of universe-basic concepts- Origin of names: planets, months, days of week.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	The Moon: Phases of moon- solar and Lunar eclipse- Seasons- Calendars.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

III	Religion and astronomy: Christianity- Islam- Hinduism.	7	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Constellations: Astronomical facts-zodiac constellations-astronomy versus astrology.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Practical Astronomy: Telescopes and its handling - Sky observations.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. The rough guide to universe by John Scalzi, Rough guide Ltd.
   Unit 1: Part 1 - Chapter 1
   Unit 2: Part 1 - Chapter 4
   Unit 4: Part 2 - Chapter 1, 2, 3
2. Atlas of the universe by Sir. Patrick Moore.
   Unit 1: Section 5
   Unit 2: Sections 2.11 - 2.14
   Unit 4: Section 6
   Unit 5: Section 1
3. Intersections of Religion and Astronomy by Aaron Ricker, Chris Corbally.
   Unit 3: Part 1 - Sections 1, 2, 3 & 7, Part 2 - Sections 8,11, Part 3 - Sections 12, 13, 16, 17

Suggested Readings

1. Extra galactic Astronomy and Cosmology by Peter Schneider Springer.
2. Astronomy for graduate and post graduate classes by Rukmani Ramachandran.
3. Astronomy- A self-teaching guide by Dinah. l. Moche, John Wiley & Sons Inc.

Web Resources

1. https://starchild.gsfc.nasa.gov/docs/StarChild/questions/question48.html
2. https://www.cgg.org/index.cfm/library/bqa/id/118/what-are-origins-of-names-our-days-months.html
3. https://www.timeanddate.com/calendar/aboutseasons.html
4. http://www.hindupedia.com/en/Astronomy
5. https://www.metmuseum.org/toah/hd/astr/hd_astr.htm
6. http://w.astro.berkeley.edu/~kalas/ethics/documents/coi/Modern%20Astronomy,%20the%20Bible,%20and%20Creation.pdf

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive Level
CO1	To familiarize with the fundamentals of astronomy.	K1, K2
CO2	To classify the reasons behind the celestial events.	K3
CO3	To analyze the occurrence of astronomical events	K4
CO4	To compare the general beliefs with celestial motion.	K5
CO5	To arrange astronomical instruments and compiling star maps.	K6

CL AND CO BASED CIA QUESTION PAPER FORMAT FOR UG THEORY COURSES MC, AR, AO, MS, ME, GL and NME*
(Excluding other languages)

SECTION	MARKS	Q. NO	K1	K2	K3	K4	K5	K6
A	Answer ALL (6 x 1 = 6)	1	+					
		2	+					
		3	+					
		4		+				
		5		+				
		6		+				
B	Answer 1 out of 2 (1 x 6 = 6)	7			+			
		8			+			
C	Answer 1 out of 2 (1 x 6 = 6)	9				+		
		10				+		
D*	Answer 1 out of 2 (1 x 12 = 12)	11					+	
		12						+
No. of CL based Questions with Max. marks			3 (3)	3 (3)	1 (6)	1 (6)	1 (12)	1 (12)
No. of CO based Questions with Max. marks			CO1		CO2	CO3	CO4	CO5
			6 (6)		1 (6)	1 (6)	1 (12)	1 (12)

- **MC**-Major Core, **AR**-Allied Required, **AO**-Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages, **NME** - Non-Major Elective.
- **Section A** could have one or more of the following: Fill in the blanks, True or False, Match the following, Definition, Comment on, Reason out etc.,But, K1 and K2 should carry equal weightage.
- In **Section D** students have choice between K5 and K6. III Component Assessment carries 40% of CIA and the assessment(s) should be from cognitive levels **K1 to K4** and all should carry equal weightage.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI - 600034
DEPARTMENT OF MATHEMATICS
FIRST CONTINUOUS INTERNAL ASSESSMENT - AUGUST 2021
UMT 2501 - ANALYTICAL GEOMETRY (MC)

I B.Sc. Mathematics 22.08.2021

Time: 10.00 a.m. to 11.30 a.m. Max. Marks: 30

SECTION A			
Answer ALL the Questions in one or two sentences		**(6 x 1 = 6 Marks)**	
1.	Give brief notes on conjugate diameters of an ellipse.	K1	CO1
2.	Define rectangular hyperbola.	K1	CO1
3.	State the condition for two lines to be coplanar.	K1	CO1
4.	Describe a sphere.	K2	CO1
5.	Differentiate hyperbola from parabola.	K2	CO1
6.	Write about a cone.	K2	CO1
SECTION B			
Answer any ONE of the following in 100 words		**(1 x 6 = 6 Marks)**	
7.	Determine the locus of the poles of all tangents to the parabola $y^2 = 4ax$ with respect to the parabola $y^2 = 4bx$.	K3	CO2
8.	Discover the equation of the plane passing through the points (2, 5, -3), (-2, -3, 5) and (5, 3, -3).	K3	CO2
SECTION C			
Answer any ONE of the following in 100 words		**(1 x 6 = 6 Marks)**	
9.	If chords of a parabola are drawn through a fixed point, then show that the locus of the middle points is another parabola.	K4	CO3
10.	Calculate the shortest distance between the lines $\frac{x-3}{-1} = \frac{y-1}{4} = \frac{z+2}{1}$, $\frac{x-1}{1} = \frac{y+7}{3} = \frac{z+2}{2}$.	K4	CO3
SECTION D			
Answer any ONE of the following in 200 words		**(1 x 12 = 12 Marks)**	
11.	Trace the curve $\frac{10}{r} = 3\cos\theta + 4$.	K5	CO4
12.	Categorize and formulate various forms of straight lines in three dimensions. Also compute the symmetrical form of the line $3x - 2y + z - 1 = 0 = 5x + 4y - 6z - 2$.	K6	CO5

CL AND CO BASED END SEMESTER EXAMINATION QUESTION PAPER FORMAT FOR UG THEORY COURSES
(MC, AR, AO, MS, ME and GL)

SECTION		Q. NO	K1	K2	K3	K4	K5	K6
A	Answer ALL (4 x 5 = 20)	1	+					
		2	+					
		3		+				
		4		+				
B	Answer 2 out of 4 (2 x 10 = 20)	5			+			
		6			+			
		7			+			
		8			+			
C	Answer 2 out of 4 (2 x 10 = 20)	9				+		
		10				+		
		11				+		
		12				+		
D	Answer 2 out of 4 (2 x 20 = 40)	13					+	
		14					+	
		15						+
		16						+
No. of CL based Questions with Max. marks			2 (10)	2 (10)	2 (20)	2 (20)	2 (40)	2 (40)
No. of CO based Questions with Max. marks			CO 1		CO 2	CO 3	CO 4	CO 5
			4 (20)		2 (20)	2 (20)	2 (40)	2 (40)

- **MC**-Major Core, **AR**-Allied Required, **AO**-Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages.
- **Section A** could have one or more of the following: Fill in the blanks, True or False, Match the following, Definition, Comment on, Reason out, but K1 andK2 should carry equal weightage.
- In **Section D** students have choice between K5 and K6.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI - 600034
DEPARTMENT OF MATHEMATICS
END SEMESTER EXAMINATION - NOVEMBER 2021
UMT 2501 - ANALYTICAL GEOMETRY (MC)

I B.Sc. Mathematics 22.11.2021

Duration: 3 Hrs Max. Marks: 100

SECTION A			
Answer ALL the Questions			
1.	**Answer the following** **(5 x 1 = 5 Marks)**		
a)	Give brief notes on conjugate diameters of an ellipse.	K1	CO1
b)	Define rectangular hyperbola.	K1	CO1
c)	What are direction cosines?	K1	CO1
d)	Write the general equation of a sphere.	K1	CO1
e)	Name the four types of conic sections.	K1	CO1
2.	**Fill in the blanks** **(5 x 1 = 5 Marks)**		
a)	If e is the eccentricity of the conic, where e<1, then the conic generated is _____.	K1	CO1
b)	The hyperbola which has the asymptotes $lx + my + n = 0$ and $l_1x + m_1y + n_1 = 0$ is _____.	K1	CO1
c)	If $Ax + By + C = 0$ is the equation of a straight line, then the pole for the line is _____.	K1	CO1
d)	The general form of the equation of the sphere is _____.	K1	CO1
e)	The section of the right circular cone by a plane perpendicular to its axis is _____.	K1	CO1
3.	**Choose the correct answer for the following** **(5 x 1 = 5 Marks)**		
a)	If e is the eccentricity of the conic, where e<1, then the conic generated is (i) parabola (ii) ellipse (iii) hyperbola (iv) circle	K2	CO1
b)	The hyperbola which has the asymptotes $lx + my + n = 0$ and $l_1x + m_1y + n_1 = 0$ is (i) $(lx + my + n = 0)(l_1x + m_1y) = 0$ (ii) $(lx + my + n = 0)(l_1x + m_1 + n_1) = 0$ (iii) $(lx + my + n = 0)(l_1x + y + n_1) = 0$ (iv) $(lx + my + n = 0)(l_1x + m_1y + n_1) = 0$	K2	CO1
c)	If $Ax + By + C = 0$ is the equation of a straight line, then the pole for the line is (i) $\left(\frac{C}{A}, -\frac{2aB}{A}\right)$ (ii)$\left(\frac{C}{A}, \frac{2aB}{A}\right)$ (iii) $\left(-\frac{C}{A}, -\frac{2aB}{A}\right)$ (iv) $\left(-\frac{C}{A}, \frac{2aB}{A}\right)$	K2	CO1
d)	What is the centre of the sphere $x^2 + y^2 + z^2 + 2ux + 2vy + 2wz + d = 0$?	K2	CO1

	(i) (u, v, w) (ii) $(-u, v, w)$ (iii) $(u, -v, w)$ (iv) $(-u, -v, -w)$		
e)	The section of the right circular cone by a plane perpendicular to its axis is (i) parabola (ii) ellipse (iii) hyperbola (iv) circle	K2	CO1
4.	**Say TRUE or FALSE**	**(5 x 1 = 5 Marks)**	
a)	The equation of the tangent at the point (x_1, y_1) on the parabola $y^2 = 4ax$ is given by $yy_1 = 2a(x + x_1)$.	K2	CO1
b)	The equation of the asymptotes differs from that of the hyperbola only in the constant term.	K2	CO1
c)	Two straight non-intersecting lines in space are called non-skew lines.	K2	CO1
d)	The plane passing through the centre of the sphere is called a circle.	K2	CO1
e)	A surface generated by a straight line which passes through a fixed point and makes a constant angle with a fixed straight line through the fixed point is a cylinder.	K2	CO1
	SECTION B		
Answer any TWO of the following in 150 words		**(2 x 10 = 20 Marks)**	
5.	Determine the locus of the poles of all tangents to the parabola $y^2 = 4ax$ with respect to the parabola $y^2 = 4bx$.	K3	CO2
6.	Develop the asymptotes of the hyperbola $3x^2 - 5xy - 2y^2 + 17x + y + 14 = 0$.	K3	CO2
7.	Discover the equation of the plane passing through the points (2, 5, -3), (-2, -3, 5) and (5, 3, -3).	K3	CO2
8.	Examine the equation of the cone with vertex O and base curve, the conic in which the surface $ax^2 + by^2 + cz^2 = 1$ is cut by the plane $l_1x + m_1y + n_1z = p$.	K3	CO2
	SECTION C		
Answer any TWO of the following in 150 words		**(2 x 10 = 20 Marks)**	
9.	If chords of a parabola are drawn through a fixed point, then show that the locus of the middle points is another parabola.	K4	CO3
10.	Examine the tangent to a rectangular hyperbola terminated by its asymptotes, is bisected at the point of contact and encloses triangle of constant area.	K4	CO3
11.	Calculate the shortest distance between the lines $\frac{x-3}{-1} = \frac{y-1}{4} = \frac{z+2}{1}, \frac{x-1}{1} = \frac{y+7}{3} = \frac{z+2}{2}$.	K4	CO3
12.	Develop the equation of the sphere whose centre is (6,-1,2) and touches the plane $2x - y + 2z - 2 = 0$.	K4	CO3
	SECTION D		
Answer any TWO of the following in 250 words		**(2 x 20 = 40 Marks)**	
13. a)	Trace the curve $\frac{10}{r} = 3\cos\theta + 4$.	K5	CO4
b)	Determine the equation of the image of the line $\frac{x-1}{2} = \frac{y+2}{-5} = \frac{z-3}{2}$ in the plane $2x - 3y + 2z + 3 = 0$.	K5	CO4

14.	a)	Let the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ meet the axes at A, B, C. Find the equation of the circumcircle of the triangle and predict the coordinates of the centre and radius.	K5	CO4
	b)	Determine the equation of the sphere passing through the points (2, 3, 1), (5, -1, 2), (4, 3, -1) and (2, 5, 3).	K5	CO4
15.	Categorize and formulate various forms of straight lines in three dimensions. Also compute the symmetrical form of the line $3x-2y+z-1=0=5x+4y-6z-2$.		K6	CO5
16.	Prove that the plane $2x-y-2z=16$ touches the sphere $x^2+y^2+z^2-4x+2y+2z-3=0$ and find their point of contact.		K6	CO5

UNIT WISE DISTRIBUTION OF CL AND CO BASED QUESTIONS AND MARKS FOR END OF SEMESTER QUESTION PAPER SETTING FOR UG COURSES (MC, AR, AO, MS, ME and GL)

	SECTION A (1 Mark/Question)		SECTION B (10 Marks/Question)	SECTION C (10 Marks/Question)	SECTION D (20 Marks/Question)	
	K1	**K2**	**K3**	**K4**	**K5**	**K6**
UNIT I	2 (1)	2 (1)	-	1 (10)	-	
UNIT II	2 (1)	2 (1)	1 (10)	1 (10)	1 (20)	-
UNIT III	2 (1)	2 (1)	1 (10)	1 (10)	1 (20)	-
UNIT IV	2 (1)	2 (1)	1 (10)	1 (10)	-	1 (20)
UNIT V	2 (1)	2 (1)	1 (10)	-	-	1 (20)
No. of CL based Questions with Max. Marks	**10 (10)**	**10 (10)**	**2 (20)**	**2 (20)**	**2 (40)**	**2 (40)**
No. of CO based Questions with Max. Marks	**CO1**		**CO2**	**CO3**	**CO4**	**CO5**
	20 (20)		**2 (20)**	**2 (20)**	**2 (40)**	**2 (40)**

MC-Major Core, **AR**-Allied Required, **AO**-Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages.

In **Section D** students have choice between K5 and K6.

CL AND CO BASED MARKS DISTRIBUTION FOR DIRECT ASSESSMENTS OF UG COURSES MC, AR, AO, MS, ME and GL

SECTION	CL	CO	CIA I	CIA II	III Component	Semester	Total (200)	CL and CO %
A	K1, K2	CO1	6	6	20	20	52	26%
B	K3	CO2	6	6	10	20	42	21%
C	K4	CO3	6	6	10	20	42	21%
D	K5, K6	CO4, CO5	12	12	-	40	64	32%

MC-Major Core, **AR**-Allied Required, **AO**-Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages.

CL AND CO BASED CIA AND SEMESTER QUESTION PAPER FORMAT FOR UG LAB COURSES* (MC, AR, AO, ME)

SECTION	MARKS	Q. NO	K1	K2	K3	K4	K5	K6
A	20	1	+					
		2		+				
B	20	3			+			
C	20	4				+		
D	20	5					+	
E	20	6						+
No. of CL based Questions with Max. marks			1(10)	1(10)	1(20)	1(20)	1(20)	1(20)
No. of CO based Questions with Max. marks			CO 1		CO 2	CO 3	CO 4	CO 5
			2(20)		1(20)	1(20)	1(20)	1(20)

No Comp III for Lab Courses and total marks assigned to CIA is 50

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI - 600034

PG & Research Department of Mathematics

FIRST CONTINUOUS INTERNAL ASSESSMENT - JULY 2021

UMT 6706 - PROGRAMMING NUMERICAL METHODS USING C & PYTHON LAB

III B.Sc. 22.07.2021

Time: 10.00 am - 11.30 am Max. Marks: 50

SECTION A			
Answer ALL the questions			**(5 × 2 = 10)**
1	Define transcendental and Algebraic equations. Illustrate them.	K1	CO1
2	Mention any four selection statements used in C.	K2	CO1
SECTION B			
Answer the following			**(10 × 1 = 10)**
3	Apply the formula of regula falsi method in writing a C code to find a root of the function $xe^x = 3$.	K3	CO2
SECTION C			
Answer the following			**(10 × 1 = 10)**
4	Solve the "The system of Linear Equations using Gauss Seidal iteration method" by using C coding.	K4	CO3
SECTION D			
Answer the following			**(10 × 1 = 10)**
5	Analyse the equation $x = \sqrt{10}$ using C code in the following methods: a) Iterative Method b) Successive approximation Method	K5	CO4
SECTION E			
Answer the following			**(10 × 1 = 10)**
6	Observation note book	K6	CO5

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI - 600034
PG & Research Department of Mathematics
END SEMESTER EXAMINATION - OCTOBER 2021
UMT 6706 - PROGRAMMING NUMERICAL METHODS USING C & PYTHON LAB

III B.Sc. 22.10.2021
Duration: 3 Hrs Max. Marks: 100

SECTION A			
Answer ALL the questions			**(10 × 2 = 20)**
1	Write a C program to find the roots of non-linear equations using Bisection Method.	K1	CO1
2	Write the PYTHON coding to calculate the factors of an integer.	K2	CO1
SECTION B			
Answer the following			**(20 × 1 = 20)**
3	Record, Observation Note Book and viva.	K3	CO2
SECTION C			
Answer the following			**(20 × 1 = 20)**
4	Write a C program for false position method using x1-exp(-x1)	K4	CO3
SECTION D			
Answer the following			**(20 × 1 = 20)**
5	Explore the quadratic function visually using PYTHON coding.	K5	CO4
SECTION E			
Answer the following			**(20 × 1 = 20)**
6	Illustrate the following using PYTHON coding. a) Mandelbrot set. b) Area between the two functions $f(x) = x^2$ and $g(x) = x^2$ which encloses an area between $x = 0$ and $x = 1.0$.	K6	CO5

COMPONENT III ASSESSMENTS AND RUBRICS

Assessing students on continuous basis is one of the significant features of LOCF curriculum. The Course faculty has the choice to decide one of the following as component III for a particular course.

(a) Mini project
(b) Seminar and MCQ
(c) Assignment and MCQ

(a) Mini Project

The project work is included as part of the curriculum to impart research skills. It is optional for UG students. They are encouraged to select research problems relevant to society and environment. The project report of UG students will be evaluated by examiners and the students will present their work in viva voce.

Rubrics for evaluation of mini project

S. No	Criteria	Max. Marks
1.	Description of the problem	10
2.	Review of literature	10
3.	Mathematical Techniques/tools	20
4.	Results	20
5.	Significance of findings	15
6.	Report/Dissertation	15
7.	Presentation	10

(b) Seminar and MCQ / (c) Assignment and MCQ

Seminars are optional to UG. Topics for the seminar are suggested by the course faculty and the students are encouraged to collect exhaustive information on the chosen topic, arrange them in order and make a presentation. They are expected to use visual aids, models, tools for the presentation and circulate relevant literature to the students.

Rubrics for evaluation of seminar/assignment

S. No.	Criteria	Max. Marks
1.	Topic introduction & literature survey	5
2.	Presentation methodology	15
3.	Articulation/Communication skills	10
4.	Discussion and Interaction	5
5.	Summary and Conclusion	5

RUBRICS FOR INTERNSHIP

Internship is a part of UG curriculum at Loyola College, Chennai. It allows the students to gain hands on experience and industry exposure. It has to be done by students during the Christmas vacation for a stipulated period of time. The UG students will be guided to choose an organization /industry where the internship is to be carried out. The activities carried out during this period would be submitted as an internship report by every student.

Rubrics for evaluation of Internship

S. No	Criteria	Max. Marks
1.	Industry/Organization profile	10
2.	Thrust areas and specialization	10
3.	Internship module and participation	20
4.	Regularity and hands on training	10
5.	Presentation/Demonstration	25
6.	Report writing	25