Department of Mathematics (UG)

SYLLABUS AND REGULATIONS

Under

OUTCOME BASED EDUCATION

2020

(Effective for the Batch of Students Admitted from 2020-2021)

AUXILIUM COLLEGE (Autonomous)

(Accredited by NAAC with A+ Grade with a CGPA of 3.55 out of 4 in the 3rd Cycle)

Gandhi Nagar, Vellore-632 006

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AUXILIUM COLLEGE (Autonomous)
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Department of Mathematics UG)

OUTCOME BASED EDUCATION - 2020

(Effective for the Batch of Students Admitted from 2020-2021)

A) INSTITUTION LEVEL

Vision:

The vision of the college is the education of young women especially the poorest to become empowered and efficient leaders of integrity for the society.

Mission:

To impart higher education to the economically weak, socially backward and needy students of Vellore and neighbouring districts.

B) NAME OF THE PROGRAMME: B.Sc. Mathematics

Vision:

To enhance the logical reasoning, analytical thinking and problem-solving skills of the students and prepare them to be lifelong learners who will be socially responsible to navigate the complexities of a rapidly changing society.

C) ELIGIBILITY CRITERIA OF THE PROGRAMME

A candidate who has qualified in Higher Secondary Examination conducted by Government of Tamil Nadu or an examination accepted as equivalent thereto by the Syndicate with Physics as one of the subjects is eligible for seeking admission to the B.Sc. Mathematics course.

D) List of courses

Sem	Part	Paper Code	Title of Subject	Hours/ Week	Exam Hours		Credits	Marks
					Th	Pr		
I	I	ULTAA20	Tamil Paper – I	6	3	-	3	40+60
	II	UENGA20	English Paper – I	6	3	-	3	40+60
	III	UCMAA20	Algebra and Trigonometry	4	3	-	4	40+60
	III	UCMAB20	Calculus	5	3		4	40+60
	III	UBPHA20	Allied I: Physics - I	4	3	-	4	40+60
	III	UBPHC20	Allied Practical: Physics	2	-	-	-	-
	IV		Skill Based Elective – I	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
Total				**30**			**20**	**600**
II	I	ULTAB20	Tamil Paper – II	6	3	-	3	40+60
	II	UENGB20	English Paper – II	6	3	-	3	40+60
	III	UCMAC20	Vector Analysis and Fourier series	5	3	-	4	40+60
	III	UCMAD20	Differential equations and Laplace Transforms	4	3	-	4	40+60
	III	UBPHB20	Allied I: Physics - II	4	3	-	4	40+60
		UBPHC20	Allied Practical: Physics	2	-	3	2	40+60
	IV		Skill Based Elective – II	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
Total				**30**			**22**	**700**
III	I	ULTAC20	Tamil Paper - III	5	3	-	3	40+60
	II	UENGC20	English Paper - III	6	3	-	3	40+60
	III	UCMAE20	Solid Geometry	5	3	-	4	40+60
	III	UCMAF20	Statics	5	3	-	4	40+60
	III	UAMSA20	Allied II: Mathematical Statistics - I	6	3	-	5	40+60
	IV	USMAAn20	Skill Based Elective – III: Numerical Methods	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
Total				**30**			**21**	**600**

Sem	Part	Paper Code	Title of Subject	Hours/ Week	Exam Hours		Credits	Marks
					Th	Pr		
IV	I	ULTAD20	Tamil Paper - IV	5	3	-	3	40+60
	II	UENGD20	English Paper - IV	6	3	-	3	40+60
	III	UCMAG20	Operations Research	4	3	-	4	40+60
	III	UCMAH20	Dynamics	4	3	-	4	40+60
	III	UAMSB20	Allied II: Mathematical Statistics - II	6	3	-	5	40+60
	IV	USMABn20	Skill Based Elective – IV: R Programming Language	2	2	-	2	40+60
	IV	UNEVS20	Environmental Studies	2	3	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
Total				**30**			**23**	**700**
V	III	UCMAI20	Abstract Algebra	6	3	-	5	40+60
	III	UCMAJ20	Real Analysis - I	6	3	-	6	40+60
	III	UCMAK20	Complex Analysis	6	3	-	5	40+60
	III	UEMAA20 UEMAC20	Elective I A: Programming in C Elective I B: Number Theory	4	3	-	3	40+60
	III	UEMAB20	Elective Practical I: C	2	-	3	2	40+60
	IV	-	Non-Major Elective - I	3	3	-	2	40+60
	IV	USMAC20	Skill Based Elective – V: Mathematics for Competitive Examinations	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
Total				**30**			**25**	**700**
VI	III	UCMAL20	Linear Algebra	6	3	-	6	40+60
	III	UCMAM20	Real Analysis - II	6	3	-	6	40+60
	III	UEMAD20 UEMAE20	Elective II A: Graph Theory Elective II B: Discrete Mathematics	6	3	-	5	40+60
	III	UEMAF20	Elective III: Object Oriented Programming Using C++	4	3	-	3	40+60
	III	UEMAG20	Elective Practical II:C++	2	-	3	2	40+60
		-	Non-Major Elective - II	3	3	-	2	40+60
	IV	USMAD20	Skill Based Elective – VI: Fuzzy Set Theory	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	2	-	2	40+60
		Total		**30**			**28**	**800**
	V	Extension Activities					**1**	-
Grand Total							**140**	**4200**

E) Programme Outcomes (PO)

On completion of the Undergraduate Programme (UG), students will be able to:

PO1: Attain knowledge and understand the principles and concepts in the respective discipline.

PO2: Acquire and apply analytical, critical and creative thinking, and problem solving skills

PO3: Effectively communicate general and discipline-specific information, ideas and opinions.

PO4: Appreciate biodiversity and enhance eco-consciousness for sustainable development of the society.

PO5: Emulate positive social values and exercise leadership qualities and team work.

PO6: Pursue higher knowledge, qualify professionally, enhance entrepreneurial skills and contribute towards the needs of the society.

F) Programme Specific Outcomes (PSO)

PSO1: Disciplinary knowledge

Capability to demonstrate comprehensive knowledge of Mathematics and understand one or more disciplines which form a part of an undergraduate programme of study.

PSO2: Communication skills

i. Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations.
ii. Ability to use mathematics as a precise language of communication in other branches of human knowledge and communicate long standing unsolved problems in mathematics.
iii. Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization.
iv. Ability to explain the development of mathematics in the civilizational context and its role as queen of all sciences.

PSO3: Critical thinking

Ability to employ critical thinking in understanding the concepts in every area of Mathematics.

PSO4: Analytical thinking

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

PSO5: Problem solving

i. Capability to solve problems in computer graphics using concepts of linear algebra.
ii. Capability to solve various models such as growth and decay models, radioactive decay model, drug assimilation, LCR circuits and population models using techniques of differential equations.
iii. Ability to solve linear system of equations, linear programming problems and network flow problems.
iv. Ability to provide new solutions using the domain knowledge of mathematics.

PSO6: Digital literacy

i. Capability to understand and apply the programming concepts of C and C++ to mathematical investigations and problem solving.
ii. Capability to understand and apply the programming concepts of R to statistical investigations and problem solving.

PSO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
PSO1	H	H	H	M	L	H
PSO2	H	H	H	L	M	H
PSO3	H	H	H	L	M	H
PSO4	H	H	H	M	L	H
PSO5	H	H	H	M	L	H
PSO6	H	H	H	M	H	H

(L-Low (1), M-Moderate (2), H-High (3))

SEMESTER – I
UCMAA20 – Algebra and Trigonometry

Year: I **SEM:** I	**Course Code:** UCMAA20	**Title of the Course:** Algebra and Trigonometry	**Course Type:** Theory	**Course Category:** Core	**H/W** 4	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To improve problem solving skills in Algebra
2. To deepen the knowledge in basic concepts of Trigonometry

Course Outcomes (CO)

The learners will be able to

1. Perceive the fundamental concepts in the theory of equations.
2. Solve various types of higher order equations.
3. Know about matrices and their applications.
4. Solve problems involving trigonometric functions.
5. Analyze and relate hyperbolic and circular functions.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	L
CO2	H	H	H	M	H	L
CO3	M	M	H	H	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I : **Theory of Equations** **(12 hours)**

1.1 Basic definitions (K1)
1.2 Polynomial equation(K1, K2)
1.3 Imaginary and Irrational roots(K1, K2, K3)
1.4 Symmetric functions of roots (K1, K2, K3, K4)
1.5 Sum of the powers of the roots (K1, K2, K3, K4)
1.6 Transformation of equations (K1, K2, K3, K4)

Unit II: **Theory of Equations (Continued)** **(12 hours)**

2.1 Types of Reciprocal equations (K1, K2, K3, K4)
2.2 Descarte's rule of signs (K1, K2, K3, K4)
2.3 Horner's method (K1, K2, K3, K4)
2.4 Cardon's method (K1, K2, K3, K4)
2.5 Biquadratic equations (K1, K2, K3, K4)
2.6 Ferrari's method (K1, K2, K3, K4)

Unit III: Series and Matrices **(12 hours)**

3.1 Statement of Binomial, Exponential and Logarithm series (K1)
3.2 Summation and Approximation of Series (K1, K2, K3, K4)
3.3 Types of matrices (K1, K2)
3.4 Sums on Eigen values and Eigen vectors (K1, K2, K3, K4)
3.5 Sums on Cayley-Hamilton Theorem (K1, K2, K3, K4)
3.6 Diagonalisation of a matrix (K1, K2, K3, K4)

Unit IV: Expansions of Trigonometric Functions **(12 hours)**

4.1 Formulae of Trigonometric Functions (K1)
4.2 Expansion of sin nθ, cos nθ, tan nθ (K1, K2, K3, K4)
4.3 Expansion of $\sin^n \theta$, $\cos^n \theta$ (K1, K2, K3, K4)
4.4 Expansion of sinθ, cosθ, tanθ in terms of θ (K1, K2, K3, K4)
4.5 Application of Trigonometric functions to limits (K1, K2, K3, K4)
4.6 Approximations of Trigonometric functions (K1, K2, K3, K4)

Unit V: Hyperbolic Functions **(12 hours)**

5.1 Formulae, properties of Hyperbolic Functions (K1, K2)
5.2 Sums on Hyperbolic Functions (K1, K2, K3, K4)
5.3 Formulae, properties of Inverse Hyperbolic functions (K1, K2)
5.4 Inverse hyperbolic functions (K1, K2, K3, K4)
5.5 Relation between hyperbolic and circular functions (K1, K2, K3, K4)
5.6 Logarithm of complex quantities (K1, K2, K3, K4)

Text Books:

1. T.K. Manickavachagom Pillay and others - Algebra -Volumes I and II – S.Viswanathan Printers and Publishers Pvt. Ltd., Chennai – Copyright 2013.

2. S. Narayanan and T. K. Manickavachagom Pillay – Trigonometry – S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai - Reprint 2006.

Reference Books:

1. P. Kandasamy and K. Thilagavathi – Mathematics for B.Sc. – Volume I and Volume IV, S. Chand and Co., New Delhi – First Edition, 2004.

2. Dr. S. Sudha - Algebra, Analytical Geometry and Trigonometry – Emerald Publishers – First Edition, 1998.

3. S. Arumugam and Thangapandi Issac– Classical Algebra – New Gamma Publishing House, Palayamkottai.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – I
UCMAB20 – Calculus

Year: I **SEM:** I	**Course Code:** UCMAB20	**Title of the Course:** Calculus	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To introduce basic properties of integrals
2. To understand the concepts of multiple integration
3. To improve analytical skills

Course Outcomes (CO)

The learners will be able to

1. Calculate the radius of curvature, center of curvature, evolutes and involutes.
2. Understand and find the asymptotes of rational curves.
3. Determine the area and volume by applying the technique of double and triple integrals.
4. Determine and use various techniques to solve the variety of integration problems.
5. Evaluate beta and gamma functions and apply beta and gamma functions in double and triple integrals.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	H	M	M	H	L
CO4	H	M	M	M	H	L
CO5	H	M	H	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Curvature **(15 hours)**

1.1 Radius of curvature in Cartesian coordinates (K1, K2, K3, K4)
1.2 Radius of curvature in Polar coordinates (K1, K2, K3, K4)
1.3 Centre of curvature in Cartesian coordinates (K1, K2, K3, K4)
1.4 Centre of curvature in Polar coordinates (K1, K2, K3, K4)
1.5 Circle of curvature (K1, K2, K3, K4)
1.6 Evolutes and Involutes (K1, K2, K3, K4)

Unit II: Asymptotes and Envelopes: **(15 hours)**

2.1 Asymptotes- Definition (K1, K2)
2.2 Methods of finding asymptotes of rational algebraic curves with special cases (Without proof) (K1, K2)
2.3 Envelopes – Definition (K1, K2)
2.4 Envelope for one parameter family of curves (K1, K2, K3, K4)
2.5 Problems on Envelope for one parameter family of curves (K1, K2, K3, K4)
2.6 Envelope for two parameter family of curves (K1, K2, K3, K4)

Unit III: Integration **(15 hours)**

3.1 Integration of irrational functions (K1, K2, K3, K4)
3.2 Integration of trigonometric functions (K1, K2, K3, K4)
3.3 Bernoulli's formula (K1, K2)
3.4 problems on Bernoulli's formula (K1, K2, K3, K4)
3.5 Properties of definite integrals (K1, K2, K3, K4)
3.6 Problems on definite integrals (K1, K2, K3, K4)

Unit IV: Multiple Integrals **(15 hours)**

4.1 Line integrals (K1, K2, K3, K4)
4.2 Double integrals (K1, K2, K3, K4)
4.3 Triple integrals (K1, K2, K3, K4)
4.4 Change of order of integration (K1, K2, K3, K4)
4.5 Applications of double integrals in finding area (K1, K2, K3, K4)
4.6 Applications of triple integrals in finding volume. (K1, K2, K3, K4)

Unit V: Improper Integrals **(15 hours)**

5.1 Improper integrals (Type I-Type VI) (K1, K2, K3, K4)
5.2 Improper integrals (Type VII-Type XII) (K1, K2, K3, K4)
5.3 Beta functions (K1, K2)
5.4 Gamma functions (K1, K2)
5.5 Applications of Beta in evaluation of double and triple integrals (K1, K2, K3, K4)
5.6 Applications of Gamma functions in evaluation of double and triple integrals (K1, K2, K3, K4)

Text Book:

1. S. Narayanan and Manickavachagom Pillai T.K - Calculus - S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai - Reprint 2007

Reference Books:

1. N.P. Bali - Differential Calculus - Volume I - Lakshmi Publication - 3rd Edition 2000
2. N.P. Bali - Integral Calculus - Lakshmi Publication – Fifth Edition - 1985
3. P.R.Vittal - Calculus - Margham Publications - Reprint 2005.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – II
UCMAC20 – Vector Analysis and Fourier Series

Year: I **SEM:** II	**Course Code:** UCMAC20	**Title of the Course:** Vector Analysis and Fourier Series	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To understand the fundamental concepts of vector analysis and apply the various techniques of vector integration in solving volume and surface integrals
2. To define Fourier series and express periodic functions as infinite series

Course Outcomes (CO)

The learners will be able to

1. Compute divergence, curl, directional derivatives and Gradients.
2. Calculate the unit normal and tangent to the surface.
3. Evaluate line integrals, surface integrals and volume integrals using vector integration.
4. Verify and Apply Green's Theorem, Gauss divergence Theorem, Stoke's Theorem.
5. Understand the nature of the Fourier series and find the Fourier coefficients.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	H	M	M	H	L
CO4	H	M	M	M	H	L
CO5	H	M	H	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Differentiation of Vectors **(15 hours)**

1.1 Scalar and vector point functions (K1, K2, K3, K4)
1.2 Derivative of product of vectors (K1, K2, K3, K4)
1.3 Definition of del operator and gradient of a scalar point function (K1, K2, K3, K4)
1.4 Determination of unit tangent and unit normal vectors (K1, K2, K3, K4)
1.5 Directional derivative – Angle between two surfaces (K1, K2, K3, K4)
1.6 Equation of tangent plane – Equation of normal to the given surface. (K1, K2, K3, K4)

Unit II: Differentiation of Vectors (Continued) **(15 hours)**

2.1 Divergence of a vector (K1, K2, K3, K4)
2.2 Curl of a vector (K1, K2, K3, K4)
2.3 Solenoidal vectors (K1, K2, K3, K4)
2.4 Irrotational vectors (K1, K2, K3, K4)
2.5 Vector identities and their applications (K1, K2, K3, K4)
2.6 Laplacian differential operator and its applications. (K1, K2, K3, K4)

Unit III: Integration of Vectors **(15 hours)**

3.1 Integration of point functions (K1, K2, K3, K4)
3.2 Line integrals (K1, K2, K3, K4)
3.3 Surface integrals (K1, K2, K3, K4)
3.4 Problems on Surface integrals (K1, K2, K3, K4)
3.5 Volume integrals (K1, K2, K3, K4)
3.6 Problems on Volume integrals (K1, K2, K3, K4)

Unit IV: Integral Theorems **(15 hours)**

4.1 Statement of Gauss Divergence theorem (K1, K2)
4.2 Verification of Gauss Divergence theorem (K1, K2, K3, K4)
4.3 Applications of Gauss Divergence theorem (K1, K2, K3, K4)
4.4 Statement of Green's theorem – Verification of Green's theorem (K1, K2, K3, K4)
4.5 Application of Green's theorem – Statement of Stokes' theorem v
4.6 Verification of Stokes' theorem – Applications of Stokes' theorem (K1, K2, K3, K4).

Unit V: Fourier series **(15 hours)**

5.1 Fourier series – Definition (K1, K2)
5.2 Finding Fourier Coefficients for a given function (K1, K2, K3, K4)
5.3 Finding Fourier Coefficients for a given periodic function with period 2π (K1, K2, K3, K4)
5.4 Finding Fourier Coefficients for odd functions (K1, K2, K3, K4)
5.5 Finding Fourier Coefficients even functions (K1, K2, K3, K4)
5.6 Half-range Series (K1, K2, K3, K4)

Text Books:

1. Duraipandian and Lakshmi Duraipandian – Vector Analysis – Emerald Publishers, Reprint 1998.

2. S. Naryanan and T.K. ManickavachagomPillai – Calculus vol. III – S. Viswanathan printers and publishers pvt. Ltd., Chennai, 2007.

Reference Books:

1. Murray R. Spiegel – Vector Analysis – Tata McGraw Hill Publishing Company Ltd., New Delhi, Copyright1974.
2. S.Narayanan and T.K. ManicakavachagomPillai – Vector Algebra and Analysis – S.Viswanathan Publishers, 1991.
3. P.R.Vittal - Differential equations, Fourier series and Laplace Transforms - Margham Publication – Third Edition, 2002.
4. M. D. Raisinghania, H. C. Saxena, H. K. Dass – Vector Calculus, S. Chand and Company Ltd., First Edition, 1999.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – II

UCMAD20 – Differential Equations and Laplace Transforms

Year: I **SEM:** II	**Course Code:** UCMAD20	**Title of the Course:** Differential Equations and Laplace Transforms	**Course Type:** Theory	**Course Category:** Core	**H/W** 4	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To improve problem solving skills in Differential Equations and Laplace Transforms
2. To expose students to different techniques of finding solution to these equations.

Course Outcomes (CO)

The learners will be able to

1. Solve the standard forms of first order differential equations.
2. Solve the second order differential equations with constant coefficients and variable coefficients.
3. Find the complete, singular and general integral of PDE.
4. Analyze the properties of Laplace Transforms.
5. Solve differential equations using Laplace Transforms.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	L
CO2	H	H	M	L	H	L
CO3	M	M	H	M	H	L
CO4	H	M	M	H	M	L
CO5	H	H	M	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: First Order Differential Equations (**12 hours)**

1.1 Introduction and Definitions of Differential Equations (K1, K2)
1.2 First order higher degree(K1, K2, K3, K4)
1.3 Solvable for p, x and y. (K1, K2, K3, K4)
1.4 Solving Clairaut's form(K1, K2, K3, K4)
1.5 Exact differential equations(K1, K2, K3, K4)
1.6 Total differential equations Pdx + Qdy + Rdz = 0 (K1, K2, K3, K4)

Unit II: Second Order Differential Equations (**12 hours)**

2.1 Introduction of Second order differential equations (K1)
2.2 Sums on Second order equations with constant coefficients (K1, K2, K3, K4)
2.3 Finding P.I for $e^{ax}V$, where V is x^m, cosmx, sinmx (m is a positive constant) (K1, K2, K3, K4)
2.4 Solving Second order differential equations (K1, K2, K3, K4)
2.5 Second order differential equations with variable coefficients (K1, K2, K3, K4)
2.6 Method of variation of parameters. (K1, K2, K3, K4)

Unit III*:* Partial Differential Equations (**12 hours)**

3.1 Formation of P.D.E by eliminating arbitrary constants (K1, K2, K3, K4)
3.2 Formation of P.D.E by eliminating arbitrary functions (K1, K2, K3, K4)
3.3 Definition of Complete, Singular and general integral (K1, K2, K3, K4)
3.4 Solution of equations of standard types: f(p,q) = 0; f(x,p,q) = 0, f(y,p,q) = 0, f(z,p,q) =0; $f_1(x,p) = f_2(y,p)$ (K1, K2, K3, K4)
3.5 Solution of Clairaut's form (K1, K2, K3, K4)
3.6 Solution of Lagrange's method (K1, K2, K3, K4)

Unit IV: Laplace Transforms (**12 hours)**

4.1 Definition of Laplace Transform (K1, K2)
4.2 Transforms of elementary functions (K1, K2, K3, K4)
4.3 Properties of Laplace Transform (K1, K2, K3)
4.4 Laplace Transforms of derivatives (K1, K2, K3, K4)
4.5 Laplace Transforms of integrals (K1, K2, K3, K4)
4.6 Periodic function of Laplace transforms. (K1, K2, K3, K4)

Unit V: Applications of Laplace Transforms (**12 hours)**

5.1 Introduction of Inverse Laplace transforms (K1, K2)
5.2 Basic properties of Inverse Laplace Transform (K1, K2)
5.3 Sums on Inverse Laplace transform (K1, K2, K3, K4)
5.4 Introduction of linear Second order Differential equations (K1, K2)
5.5 Solution of linear ordinary differential equations of second order (K1, K2, K3, K4)
5.6 Solution of Second order differential equation with constant coefficients using Laplace Transformations (K1, K2, K3, K4)

Text Books:

1. S. Naryanan and T.K. Manickavachagom Pillai – Calculus Vol. III – S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai, 2012.
2. M. K. Venkataraman and Manorama Sridhar - Differential Equations and Laplace Transform - First Edition - 2004

Reference Books:

1. P.R.Vittal - Differential equations, Fourier and Laplace Transforms and Probability - Margham Publication – Third Edition, 2002.
2. D.A. Murray - Introduction course in Differential Equations, Orient and Longman publication, Chennai,2003.
3. Sundrapandian V – Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt. Ltd, New Delhi,2013.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – III
UCMAE20 – Solid Geometry

Year: II **SEM:**III	**Course Code:** UCMAE20	**Title of the Course:** Solid Geometry	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To introduce various concepts of three-dimensional Analytical Solid Geometry.
2. To understand and deepen the knowledge related to three-dimensional Analytical Solid Geometry.

Course Outcomes (CO)

The learners will be able to

1. Comprehend the basic concepts of plane and find the equation of a plane under given conditions.
2. Understand the basic concepts of straight line and skew lines and also find the equation of a straight line under given conditions, find the length and equations of the shortest distance between two skew lines.
3. Understand the basic concepts of sphere and find the equation of a sphere under given conditions.
4. Familiarize with cone, right circular cone, enveloping cone and reciprocal cone and also find the respective equations under given conditions.
5. Familiarize with cylinder, enveloping cylinder and right circular cylinder and also find the respective equations under given conditions.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit 1: Plane **(15 hours)**

1.1 General equation of a plane (K1, K2, K3)
1.2 Equation of a plane in intercept form (K1, K2, K3, K4)
1.3 Equation of a plane in normal form (K1, K2, K3, K4)
1.4 Angle between two planes (K1, K2, K3)
1.5 Plane through the intersection of two given planes (K1, K2, K3, K4)
1.6 Condition for the homogenous equation of the second degree to represent a pair of planes (K1, K2, K3, K4)

Unit 2: Straight Line **(15 hours)**

2.1 Symmetrical form of a straight line (K1, K2, K3)
2.2 Equation of a straight line passing through two given points (K1, K2, K3)
2.3 Expressing the equation of a line in symmetrical form (K1, K2, K3, K4)
2.4 Image of a point in the given plane (K1, K2, K3, K4)
2.5 Image of a line in the given plane (K1, K2, K3, K4)
2.6 Length and equations of the shortest distance between two skew lines (K1, K2, K3, K4)

Unit 3: Sphere **(15 hours)**

3.1 Equation of a sphere (K1, K2, K3)
3.2 Length of the tangent from a point to the given sphere (K1, K2, K3)
3.3 Equation of the tangent plane at a point to the given sphere (K1, K2, K3, K4)
3.4 Section of a sphere by a plane (K1, K2, K3, K4)
3.5 Equation of a sphere passing through a given circle (K1, K2, K3, K4)
3.6 Condition for orthogonality of two spheres (K1, K2, K3, K4)

Unit 4: Cone **(15 hours)**

4.1 Equation of a cone (K1, K2, K3, K4)
4.2 Condition for the general equation of the second degree to represent a cone (K1, K2, K3, K4)
4.3 Right Circular Cone (K1, K2, K3, K4)
4.4 Enveloping Cone (K1, K2, K3, K4)
4.5 Tangency of a plane to a cone (K1, K2, K3)
4.6 Reciprocal Cone (K1, K2, K3)

Unit 5: Cylinder **(15 hours)**

5.1 Equation of a cylinder with a given generator and a given guiding curve (K1, K2, K3, K4)
5.2 Enveloping cylinder (K1, K2, K3, K4)
5.3 Enveloping cylinder as a limiting form of an enveloping cone (K1, K2, K3)
5.4 Equation of a right circular cylinder with a given axis and a given radius (K1, K2, K3, K4)
5.5 Equation of a right circular cylinder with a given axis and passing through a given point (K1, K2, K3, K4)
5.6. Equation of a right circular cylinder passing through a circle (K1, K2, K3, K4)

Text Books:

1. P. R. Vittal – Vector Analysis, Analytical Solid Geometry & Sequences and Series - Margham Publications – Reprint 2004.

Reference Books:

1. T.K. Manickavachagam Pillay and T. Natrajan – Analytical Geometry – S. Viswanathan Printers & Publishers Pvt. Ltd. 2012.
2. P. Durai Pandian – Analytical Geometry of Three Dimensions – Mugil Publishers – Revised Edition, 1983.
3. S. G. Venkatachalapathy – Analytical Geometry - Margham Publications – First Edition, 2008.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – III
UCMAF20 - Statics

Year: II **SEM:** III	**Course Code:** UCMAF20	**Title of the Course:** Statics	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To develop broad knowledge of Statics and understanding of definitions, concepts, principles and theorems.
2. To enhance the ability of learners to apply the knowledge and skills acquired by them during the course to solve specific theoretical and applied problems in Statics.

Course Outcomes (CO)

The learners will be able to

1. Familiarize with subject matter, which has been the single center, to which mathematicians, physicists, astronomers, and engineers were drawn together.
2. Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body.
3. Understand the reduction of force system to a resultant force acting at a base point and a resultant couple, which is independent of the choice of base of reduction.
4. Understand static friction that exists between a stationary object and the surface on which it is resting and apply the knowledge and skills to solve specific theoretical and applied problems.
5. Construct center of gravity of some materialistic systems.

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	M	L

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	M	L

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Force **(15 hours)**

1.1 Newton's Laws of motion (K1,K2)
1.2 Force (K1,K2, K3)
1.3 Resultant of two forces on a particle – Book works (K1,K2, K3)
1.4 Resultant of two forces on a particle – Problems (K1,K2, K3, K4)
1.5 Resultant of three forces related to a triangle acting at a point (K1,K2, K3, K4)
1.6 Resultant of several forces acting on a particle (K1,K2, K3, K4)
(Chapter 2: Sections 2.1, 2.1.1, 2.2, 2.2.1, 2.2.2; Omit 2.1.2)

Unit II: Forces on a Rigid Body **(15 hours)**

2.1 Equilibrium of a particle under three forces (K1, K2)
2.2 Triangle of forces-Polygon of forces (K1, K2)
2.3 Lami's theorem (K1, K2, K3)
2.4 Equilibrium of a particle under several forces (K1, K2, K3)
2.5 Equilibrium of a particle – Problems (K1, K2, K3, K4)
2.6 Moment of a force – Moment of a force about a line – Scalar moment (K1, K2)
(Chapter 3: Sections 3.1, 3.1.1, 3.1.2, Chapter 4: Sections 4.1, 4.1.1, 4.1.2.).

Unit III: Forces on a Rigid Body (Continued) **(15 hours)**

3.1 Parallel forces – Point of application of resultant of many parallel forces (K1, K2, K3, K4)
3.2 Varignon's theorem (K1, K2, K3, K4)
3.3 Parallel forces at the vertices of a triangle (K1, K2, K3, K4)
3.4 Forces along the sides of a triangle (K1, K2, K3, K4)
3.5 Couples – Moment of a couple – Arm and axis of a couple (K1, K2, K3, K4)
3.6 Resultant of several coplanar forces-Moment of a certain couple as an area (K1, K2, K3, K4)
(Chapter 4: Sections 4.4, 4.4.1, 4.4.2, 4.4.3, 4.5, 4.6, 4.6.1, 4.6.2, 4.7, 4.7.1)

Unit IV: Friction **(15 hours)**

4.1 Types of forces – Friction – Definitions (K1, K2)
4.2 Laws of friction (K1, K2)
4.3 Limiting equilibrium of a particle on an inclined plane – Book Works (K1, K2, K3)
4.4 Limiting equilibrium of a particle on an inclined plane – Problems (K1, K2, K3, K4)
4.5 Problems involving frictional forces (K1, K2, K3, K4)
4.6 Problems involving frictional forces (K1, K2, K3, K4)
(Chapter 2: Section 2.1.2, Chapter 3: Section 3.2, Chapter 5: Section 5.2; Omit 5.2.1)

Unit V: Centre of Mass **(15 hours)**

5.1 Centre of mass (K1, K2)
5.2 Centre of gravity (K1, K2)
5.3 Finding mass centre -Finding mass centre (not using integration) - Theory (K1, K2, K3, K4)
5.4 Finding mass centre (not using integration) – Problems (K1, K2, K3, K4)
5.5 Finding mass centre using integration (K1, K2, K3, K4)
5.6 Finding mass centre using integration (K1, K2, K3, K4)
(Chapter 6: Sections 6.1, 6.1.1, 6.2, 6.2.1, 6.2.2)

Text Book:

1. P.Duraipandian, Laxmi Durai Pandian, Muthamizh Jayapragasam – Mechanics –S.Chand and Co. Ltd. – Sixth Rep. Edition 2007 Edition.

Reference Books:

1. K. Viswanatha Naik, M.S. Kasi – Statics – Emerald Publication, 1st Edition, 1987.
2. M.K. Venkatraman – Statics – Agasthiar Publication, 9th Edition, 1999.
3. A Ruina and R. Pradap, Introduction to Statics and Dynamics, Oxford University Press, 2014

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – III
UAMSA20 – Mathematical Statistics I

Year: II **SEM:** III	**Course Code:** UAMSA20	**Title of the Course:** Mathematical Statistics-I	**Course Type:** Theory	**Course Category:** Allied	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To study Statistics from a purely mathematical standpoint using Probability theory as well as other branches of Mathematics.
2. To understand the concepts of random variables and probability functions.
3. To demonstrate knowledge of probability and the standard statistical distributions.
4. To recognize the fundamental meanings of correlation and regression.

Course Outcomes (CO)

The learners will be able to

1. Comprehend the fundamentals of probability.
2. Know about random variables of one and two dimensions.
3. Learn about the measures of central tendency and concepts of moments.
4. Acquire knowledge about discrete and continuous distributions.
5. Apply correlation and regression for the investigation of relationship between the variables.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	H	L
CO2	H	H	H	H	H	M
CO3	H	M	H	H	H	L
CO4	H	H	H	H	H	M
CO5	H	H	M	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Theory of Probability **(18 hours)**

1.1 Definition of probability and basics (K1, K2)
1.2 Independence of events (K1, K2, K3)
1.3 Addition theorem (K1, K2)
1.4 Conditional probability (K1, K2, K3)
1.5 Multiplication Law of probability (K1, K2, K3, K4)
1.6 Bayes' theorem (K2, K3, K4)

Unit II: Random Variables **(18 hours)**

2.1 Discrete and continuous random variables - Probability distribution and distribution Function (K1, K2, K3)
2.2 Definition of two-dimensional random variable (K1K2)
2.3 Probability distribution (K2, K3, K4)
2.4Probability density function (K2, K3, K4)
2.5 Marginal and conditional distributions (K1, K2, K3, K4)
2.6 Stochastic independence of random variables (K2, K3)

Unit III: Characteristics of Random Variables **(18 hours)**

3.1 Mathematical Expectation and Properties (K1, K2, K3)
3.2 Variance, Standard deviation, Mean deviation (K1, K2, K3)
3.3 Tchebychev's inequality (K2, K3, K4)
3.4Raw and central moments and relation between them (K1, K2, K3)
3.5 Moment generating function (mgf) and properties of mgf (K1, K2, K3, K4)
3.6 Uniqueness theorem (statement only), Characteristic function and properties (K1, K2, K3, K4)

Unit IV: Standard Distributions **(18 hours)**

4.1 Binomial distribution (K1, K2, K3, K4)
4.2 Poisson distribution (K1, K2, K3, K4)
4.3 Normal distribution (K1, K2, K3,)
4.4 Normal distribution (continued) (K1, K2, K3, K4)
4.5 Uniform distribution (K1, K2, K3)
4.6 Rectangular distribution. (K1, K2, K3)

Unit V: Correlation and Regression **(18 hours)**

5.1 Correlation, types of correlation and Karl Pearson's coefficient of correlation (K1, K2)
5.2 Properties of correlation coefficient (K1, K2)
5.3 Spearman's rank correlation coefficient (K1, K2)
5.4 Computation of correlation and rank correlation coefficient for raw and grouped data (K3, K4)
5.5 Regression lines definition, derivation, angle between regression lines, regression coefficient properties (K1,K2)
5.6 Computation of regression lines for raw and grouped data. (K3, K4)

Text Book:

1. S. C. Gupta, V.K. Kapoor - Fundamentals of Mathematical Statistics - Sultan Chand & Sons, New Delhi, Third Edition, 2004.

Reference Books:

1. Hogg R.V. and Craig, A.T.- Introduction to Mathematical Statistics – Macmillan, 4th Edition 1998.
2. Mood, A.M., Graybill, F.A. and Boes, D.G.- Introduction to Theory of Statistics - McGraw Hill Publication,3rd Edition 1974.
3. Snedecor G.W., Cochran W.G. - Statistical Methods - Oxford and IBH -6th Edition 1967.
4. Hoel P.G. - Introduction to Mathematical Statistics – Wiley, 4th Edition 1971.
5. Wilks S.S. - Elementary Statistical Analysis - Oxford and IBH. Reprint 1971.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – III
USMAAn20 – Numerical Methods

Year: II **SEM:** III	**Course Code:** USMAAn20	**Title of the Course:** Numerical Methods	**Course Type:** Theory	**Course Category:** Skill Based Elective	**H/W** 2	**CREDITS** 2	**MARKS** 100

Course Objectives

1. To introduce various concepts of numerical methods.
2. To apply them and obtain the approximate solutions to mathematical problems.

Course Outcomes (CO)

The learners will be able to

1. Understand the operators of finite differences and express any value of y in terms of the forward differences of y_0 and the backward differences of y_n.
2. Apply interpolating techniques for equal intervals by Newton's method.
3. Apply central difference formulae to get the intermediate values of given data.
4. Apply interpolating techniques for unequal intervals by divided difference formula and Lagrange's interpolation formula.
5. Evaluate the gradient at any point of a graph using numerical differentiation and find the area under curved surface, velocity, etc. using numerical integration.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	M	H	L
CO2	H	H	M	H	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	H	L
CO5	H	H	M	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Finite Differences (6 hours)

First difference – Operators: $\Delta, \nabla, \mu, \delta$, E and D - Properties of operators – Relation between the operators - Express any value of y in terms of y_n and the backward differences of y_n - Differences of a polynomial – Factorial polynomial. (K1, K2, K3, K4)

Unit II: Interpolation with Equal Intervals (6 hours)

Gregory-Newton forward interpolation formula (for equal intervals) – Gregory-Newton Backward interpolation formula (for equal intervals) - Equidistant terms with one or more missing values (K1, K2, K3, K4)

Unit III: Central Difference Interpolation Formulae (6 hours)

Central differences and central differences table – Gauss's forward interpolation formula – Gauss's backward interpolation formula- Stirling's formula – Bessel's formula. (K1, K2, K3, K4)

Unit IV: Interpolation with Unequal Intervals (6 hours)

Divided differences – Properties of divided differences – Relation between divided differences and forward differences – Theorem: Newton's divided difference formula – Deduction: Deduce Gregory Newton interpolation forward formula for equal intervals- Lagrange's interpolation formula – Different form of Lagrange's interpolation formula. (K1, K2, K3, K4)

Unit V: Numerical Differentiation and Integration (6 hours)

Newton's forward difference formula to get the derivative – Newton 's Backward difference formula to get the derivative – Derivative using Stirling's formula- A general quadrature formula for equidistant ordinates–Trapezoidal rule –Simpson's one-third rule – Simpson 's three-eighth rule. (K1, K2, K3, K4)

Text Book:

1. P.Kandasamy, K.Thilagavathy and K.Gunavathy- Numerical Methods-S.Chand publication-Revised Edition 2014.

Reference Books:

1. S.G. Venkatachalapathy – Calculus of Finite Differences and Numerical Analysis, Margham Publications, First edition 2003.
2. S.Kalavathy – Numerical Methods - Thomson Learning – 5, Shenton Way, Singapore. Copy Right: 2004.
3. Dr.A.Singaravelu – Numerical Methods – Meenakshi Agency - 120, Pushpa Nagar Medavakkam, Chennai, Revised Edition: Dec 2007.

4. Dr. V.N.Vedamurthy, Dr.N.Ch.S.N. Iyengar – Numerical Methods, Vikas Publishing House Pvt. Ltd, New Delhi, Copy Right: 1998.
5. S.Arumugam, A.Thangapandi Isaac, A. Somasundaram – Numerical Methods, Second Edition - SciTech Publishing Pvt. Ltd; Chennai - Reprint: Sep 2005.
6. R.Gupta – Numerical Analysis, Laxmi Publishing Ltd., New Delhi - Revised Edition, 2001.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – IV
UCMAG20 – Operations Research

Year: II **SEM:** IV	**Course Code:** UCMAG20	**Title of the Course:** Operations Research	**Course Type:** Theory	**Course Category:** Core	**H/W** 4	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To apply problem solving skills to real life situations.
2. To develop logical and analytical skills.

Course Outcomes (CO)

The learners will be able to

1. Translate the real-world problems into linear programming problems and obtain solutions.
2. Apply the transportation problem techniques for the optimization of cost.
3. Solve the assignment problem which deals with the allocation of various sources to various destinations on one-to-one basis.
4. Find the optimum strategies of the players and the value of the 2-person games.
5. Perform network planning using PERT & CPM techniques which provide a methodology for planning and controlling of a project.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO 6**
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	L	L	H
CO4	H	H	H	L	L	H
CO5	H	H	H	L	L	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Linear Programming **(12 hours)**

1.1 Introduction (K1, K2)
1.2 Scope of OR (K1, K2)
1.3 Formulation a Linear Programming Problem (K1, K2, K3)
1.4 Graphical Method Standard Form of LPP – Simplex Method (K1, K2, K3, K4)
1.5 Standard Form of LPP – Simplex Method (K1, K2, K3, K4)
1.6 Simplex Method – Problems (K1, K2, K3, K4)

Unit II: Transportation Model **(12 hours)**

2.1 Introduction – Mathematical Formulation (K1, K2)
2.2 Finding Initial Basic Feasible Solution- North West Corner Rule (K1, K2, K3, K4)
2.3 Matrix Minima Method (K1, K2, K3, K4)
2.4 Vogel's Approximation Method – Optimality Test – MODI Method (K1, K2, K3, K4)
2.5 Unbalanced Transportation Problem (K1, K2, K3, K4)
2.6 Maximization Problem (K1, K2, K3, K4)

Unit III: Assignment Model **(12 hours)**

3.1 Assignment Model Formulation of Assignment Problem (K1, K2)
3.2 Hungarian Method (K1, K2, K3, K4)
3.3 Multiple optimal - Non Square Matrix (K1, K2, K3, K4)
3.4 Maximization of Assignment Problem (K1, K2, K3, K4)
3.5 Restrictions on Assignment (K1, K2, K3, K4)
3.6 Travelling Salesman Problem – Mathematical Formulation – Solutions to Travelling Salesman Problem (K1, K2, K3, K4)

Unit IV: Game Theory **(12 hours)**

4.1Introduction – Characteristics of Games – Definitions (K1, K2)
4.2 Two Person Zero-sum game with saddle point (K1, K2, K3, K4)
4.3 Maxmin-Minimax Principle (K1, K2, K3, K4)
4.4 Game Problems of Mixed Strategies Arithmetic and Algebraic Methods (K1, K2, K3, K4)
4.5 Method of Dominance (K1, K2, K3, K4)
4.6 Graphical Method for 2xn or mx2 games (without saddle point) (K1, K2, K3, K4)

Unit V: PERT and CPM **(12 hours)**

5.1 Introduction – Network Diagram Representation (K1, K2)
5.2 Rules for Constructing the Network (K1, K2)
5.3 Calculation and Critical path in Network Analysis (K1, K2, K3, K4)
5.4 Determination of Floats or Slack Times (K1, K2, K3, K4)
5.5 Critical path Method – Procedure of Determining the Critical path (K1, K2, K3, K4)

5.6 Program Evaluation and Review Technique (PERT). (K1, K2, K3, K4)

Text Book:

1. P.K. Gupta and D.S. Hira – Problems in Operations Research, 1st Edition – Chand and Company Ltd., 1995.

Reference Books:

1. S. Kalavathy – Operations Research, 2nd Edition – Vikas Publications Ltd., 2002.

2. S. J. Venkatesan – Operations Research, 3rd Edition – J S Publication, Printed by Udayam Offsets, Chennai, 1999.

3. V.K. Kapoor – Operations Research, 5th Edition – Sultan Chand and Sons, Educational Publishers New Delhi, Revised Reprint, 1996.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – IV
UCMAH20-Dynamics

Year: II **SEM:** IV	**Course Code:** UCMAH20	**Title of the Course:** Dynamics	**Course Type:** Theory	**Course Category:** Core	**H/W** 4	**CREDITS** 4	**HOURS** 100

Course Objectives

1. To develop balanced knowledge of Dynamics and understanding of definitions, concepts, principles and theorems in Dynamics.
2. To enhance the ability of learners to apply the knowledge and skills acquired by them during the course to solve specific theoretical and applied problems in Dynamics.

Course Outcomes (CO)

The learners will be able to

1. Familiarize with subject matter, which has been the single centre, to which mathematicians, physicists, astronomers, and engineers were drawn together.
2. Understand behaviour of motion of objects.
3. Understand simple harmonic motion and projectiles.
4. Express the effects of impact of spheres.
5. Demonstrate methods to locate central orbits.
6. Apply the knowledge and skills to solve specific theoretical and applied problems.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	M	L

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Velocity **(12 hours)**

1.1 Basic units – Velocity – Velocity of a particle describing a circle (K1, K2)
1.2 Resultant Velocity (K1, K2, K3, K4)
1.3 Relative Velocity (K1, K2, K3, K4)
1.4 Acceleration (K1, K2)
1.5 Coplanar motion - Velocity and acceleration in a coplanar motion (K1, K2, K3, K4)
1.6 Angular velocity – Relative angular velocity (K1, K2, K3, K4)
(Chapter I: Sections 1.1, 1.2, 1.2.1, 1.2.2, 1.2.3, 1.3, 1.4, 1.4.1, 1.4.2, 1.4.3; Omit 1.3.1, 1.3.2)

Unit II: Simple Harmonic Motion **(12 hours)**

2.1 Simple Harmonic motion - Definitions (K1, K2)
2.2 Simple Harmonic motion – Book works (K1, K2, K3)
2.3 Projection of a particle having a uniform circular motion (K1, K2)
2.4 Composition of two simple harmonic motions of same period. (K1, K2)
2.5 Simple Harmonic motion – Problems (K1, K2, K3, K4)
2.6 Simple Harmonic motion – Problems (K1, K2, K3, K4)
(Chapter 12: Sections 12.1, 12.1.1, 12.1.2)

Unit III: Projectiles **(12 hours)**

3.1 Forces on a projectile (K1, K2)
3.2 Displacement as a combination of vertical and horizontal displacements (K1, K2)
3.3 Nature of a trajectory – Results pertaining to the motion of a projectile - Maximum horizontal range for a given velocity (K1, K2, K3, K4)
3.4 Projectiles- Problems (K1, K2, K3, K4)
3.5 Projectile projected on an inclined plane (K1, K2, K3, K4)
3.6 Maximum range on an inclined plane (K1, K2, K3, K4)
(Chapter 13: Sections 13.1, 13.1.1, 13.1.2, 13.1.3, 13.1.4, 13.2, 13.2.1; Omit 13.1.5, 13.1.6)

Unit IV: Impact **(12 hours)**

4.1 Impact of spheres - Laws of Impact (K1, K2)
4.2 Impact of two smooth spheres (K1, K2)
4.3 Direct impact of two smooth spheres – Book works (K1, K2, K3)
4.4 Direct impact of two smooth spheres – Problems (K1, K2, K3, K4)
4.5 Oblique impact of two smooth spheres – Book works (K1, K2, K3)
4.6 Oblique impact of two smooth spheres – Problems (K1, K2, K3, K4)
(Chapter 14: Sections 14.2, 14.2.1, 14.3, 14.3.1, 14.5; Omit 14.4)

Unit V: Central Orbit **(12 hours)**

5.1 Central orbit (K1, K2)
5.2 Differential Equation of a central orbit (K1, K2, K3, K4)
5.3 Laws of a central force (K1, K2)
5.4 Methods to find the central orbits (K1, K2, K3, K4)
5.5 Central orbit - Problems (K1, K2, K3, K4)
5.6 Central orbit - Problems (K1, K2, K3, K4)
(Chapter 16: Sections 16.2, 16.2.1, 16.2.2, 16.2.3)

Text Book:

1. P. Durai Pandian, Laxmi Durai Pandian, Muthamizh Jayapragasam - Mechanics – S. Chand Publishing, 6th Edition, 2015.

Reference Books:

1. K. Viswanatha Naik & M. S. Kasi – Dynamics – Emerald Publication, 1st Edition, 1987.
2. M. K. Venkatraman – Dynamics – Agasthiar Publication, 9th Edition, 1999.
3. A Ruina and R. Pradap, Introduction to Statics and Dynamics, Oxford University Press, 2014

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – IV
UAMSB20 – Mathematical Statistics II

Year: II **SEM:** IV	**Course Code:** UAMSB20	**Title of the Course:** Mathematical Statistics-II	**Course Type:** Theory	**Course Category:** Allied	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To provide a sound foundation in basic topics of modern statistical inference.
2. To study the concept of likelihood and derive the likelihood and associated functions of interest for simple models.
3. To construct confidence intervals for unknown parameters.
4. To demonstrate understanding of how to design experiments and surveys for efficiency.

Course Outcomes (CO)

The learners will be able to

1. Know the basic concepts of some advanced distributions.
2. Apply estimation theory to estimate the values of parameters.
3. Use appropriate sampling distributions for testing of hypothesis.
4. Apply chi-square test to find out the significant difference between expected and observed frequencies in one or more categories.
5. Use F-test to compare statistical model that has been fitted to a data that best fits the population from which the data was sampled.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	H	L
CO2	H	L	H	H	H	M
CO3	H	M	H	H	H	L
CO4	H	L	H	H	H	M
CO5	H	M	H	H	H	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Sampling Distributions **(18hours)**

1.1Parameter and statistic - sampling distribution - Standard error (K1, K2)
1.2Sampling distribution of statistics (K1, K2)
1.3Chi-square distribution -p.d.f derivation, moment generating function (K1, K2, K3, K4)
1.4Chi-square distribution (continued) mean, variance, additive property (K1, K2, K3, K4)
1.5Student's t distribution – moments - limiting form of t distribution (K1, K2, K3, K4)
1.6 F distribution – mean, variance (K1, K2, K3, K4)

Unit II: Parametric Estimation **(18 hours)**

2.1 Point estimation, Concept of unbiasedness, consistency, efficiency and sufficiency (K1, K2, K3)
2.2 Cramer Rao Inequality – Rao-Blackwell Theorem (K3, K4)
2.3 Methods of estimation - method of moments (K1, K2, K3, K4)
2.4 Method of maximum likelihood (K1, K2, K3, K4)
2.5 Interval Estimation - Confidence interval for mean - difference in means – proportion - difference in proportions (K1, K2, K3, K4)
2.6 Interval Estimation for variance using normal, t and Chi-square distributions (K1, K2, K3, K4)

Unit III: Tests of Significance **(18 hours)**

3.1 Tests of significance – definitions (K1, K2)
3.2 Tests of significance for large samples for mean and standard deviation (K1, K2, K3, K4)
3.3 Tests of significance for large samples for proportion and correlation coefficient (K1, K2, K3, K4)
3.4 Tests of significance for small samples – t, χ^2 test for mean and variance (K1, K2, K3, K4)
3.5 Test of significance for small samples - F test for mean, variance (K1, K2, K3, K4)
3.6 Tests of significance for small samples with regard to coefficient of correlation (K1, K2, K3, K4)

Unit IV: Chi Square Tests **(18 hours)**

4.1 Formula derivation for Chi-square test (K1, K2)
4.2 Chi-square test of goodness of fit (K3, K4)
4.3 Attribute (K1, K2, K3,)
4.4 coefficient of association (K1, K2, K3)
4.5 Contingency tables (K1, K2, K3)
4.6 Chi-square test for independence of attributes (K3, K4)

Unit V: Analysis of Variance **(18hours)**

5.1Analysis of variance-one-way and two-way classification (K1, K2, K3, K4)
5.2 Basic principles of design of experiments (K1, K2)
5.3 Randomization – Replication - Randomized Block Design (K1, K2)
5.4Randomized block design (K1, K2, K3, K4)
5.5Completely Randomized block design (K1, K2, K3, K4)
5.6 Latin Square Design (K1, K2, K3, K4)

Text Book:

1. S. C. Gupta and V. K. Kapoor - Fundamentals of Mathematical Statistics - Sultan Chand & Sons, New Delhi, Second Edition, 2004.

Reference Books:

1. Hogg R.V. and Craig, A.T. - Introduction to Mathematical Statistics, Macmillan, 4th Edition 1998.
2. Mood, A.M., Graybill, F.A. and Boes, D.G.- Introduction to Theory of Statistics - McGraw Hill Publication,3rd Edition 1974.
3. Snedecor G.W., Cochran W.G. - Statistical Methods - Oxford and IBH -6th Edition 1967.
4. Hoel P.G. - Introduction to Mathematical Statistics – Wiley, 4th Edition 1971.
5. Wilks S.S. - Elementary Statistical Analysis - Oxford and IBH Reprint 1971.

e- Resources:

1. https://nptel.ac.in/
2. https://www.cimt.org.uk/projects/mepres/alevel/fstats_ch4.pdf
3. www.coursera.org

SEMESTER – IV
USMABn20 - R Programming Language

Year: II **SEM:** IV	**Course Code:** USMABn20	**Title of the Course:** R Programming Language	**Course Type:** Theory	**Course Category:** Skill Based Elective	**H/W** 2	**CREDITS** 2	**HOURS** 100

Course Objectives

1. To introduce students to the concept of basic R programming, thereby enhancing the logical thinking of the students with regard to programming.
2. To train the students to apply the programming concepts of R to statistical investigations and problem solving.

Course Learning Outcomes (CLO)

The learners will be able to

1. Familiarize the basics of programming in R such as vectors, arrays, data frames, etc.
2. Use the Decision making-branching and looping statements in R programming.
3. Represent data and Interpret results through graphical tools in R.
4. Calculate basic statistical measures and fit standard distributions using R.
5. Understand and apply the programming concepts of R to perform tests of significance.
6. Understand and apply the programming concepts of R to perform Analysis of Variance.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	L	H
CO3	H	M	H	M	L	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Basics of R **(6 hours)**

Introduction and Preliminaries-Simple Manipulations; Numbers and Vectors-Arrays and Matrices - Lists and Data Frames-Reading Data from files (K1, K2, K3, K4)

Unit II: Decision Making and Graphical Procedures **(6 hours)**

Grouping-Loops and Conditional Execution-Graphics on R-Scatter Plot-Line Graphs-Pie Charts-Bar Plots-Histograms-Frequency Polygons (K1, K2, K3, K4)

Unit III: Statistical Measures & Probability Distributions **(6 hours)**

Mean, Median and Mode-Variance, Standard Deviation and Mean Deviation -Correlation and Regression-Standard Distributions -Binomial, Poisson and Normal Distributions (K1, K2, K3, K4)

Unit IV: Tests of significance **(6 hours)**

z-Test-Test for Mean-Test for Proportion-Comparing two Means-Comparing two proportions-Student t-test and t-test for two Means- Chi-Square Test-Test for Independence of Attributes (K1, K2, K3, K4)

Unit V: Analysis of Variance **(6 hours)**

Comparing more than two Means-Completely Randomized Design - One-Way Classification-Randomized Block Design-Two-Way Classification-Latin Square Design (K1, K2, K3, K4)

Text Books:

1. The R Book-Michael J. Crawley-Imperial College London at Silwood Park, UK, Second Edition, A John Wiley & Sons, Ltd., Publication, 2013.
2. An Introduction to R-Notes on R: A Programming Environment for Data Analysis and Graphics W. N. Venables, D. M. Smith and the R Core Team-(Version 3.6.3), 2020.

Reference Books:

1. The Art of R Programming A Tour of Statistical Software Design-Norman Matloff, No Starch Press, San Francisco, 2011.
2. Introduction to Statistics with R - Anne Segonds-Pichon, Babraham Bioinformatics, 2015.
3. R for Dummies, Andrie de Vries and Joris Meys, 2nd Edition, John Wiley & Sons, Inc., 2015.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://spoken-tutorial.org

SEMESTER – V
UCMAI20 – Abstract Algebra

Year : III **SEM :** V	**Course Code :** UCMAI20	**Title Of The Course :** Abstract Algebra	**Course Type :** Theory	**Course Category :** Core	**H/W** 6	**CREDITS** 5	**MARKS** 100

Course Objectives

1. To introduce the concepts of abstract algebra.
2. To enable understanding of fundamental algebraic structures.

Course Outcomes (CO)

The learners will be able to

1. Understand the concepts of groups and sub groups.
2. Know about normal subgroups, quotient groups, homomorphisms and isomorphisms.
3. Understand the concepts of automorphisms for constructing new groups from the given groups.
4. Have knowledge on concepts of ring theory.
5. Understand the concepts of maximal ideals, Euclidean rings and particular integral domain.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Group Theory **(18 hours)**

1.1 Definition of a group (K1, K2)
1.2 Examples of groups (K1, K2, K3)
1.3 Some preliminary lemmas (K2, K3)
1.4 Subgroups (K1, K2, K3)
1.5 Lagrange's theorem, corollaries to Lagrange's theorem (K1, K2, K3, K4)
1.6 A Counting Principle (K1, K2, K3, K4)
(Chapter 2: Sections 2.1, 2.2, 2.3, 2.4, 2.5)

Unit II: Group Theory (Continued) **(18 hours)**

2.1 Normal subgroups (K1, K2, K3)
2.2 Quotient groups (K1, K2, K3)
2.3 Homomorphisms (K1, K2, K3)
2.4 Kernel of a homomorphism (K1, K2, K3)
2.5 Isomorphisms (K1, K2, K3)
2.6 Theorems on isomorphisms (K1, K2, K3, K4)
(Chapter 2: Sections 2.6, 2.7; Omitting applications 1 and 2)

Unit III: Group Theory (Continued) **(18 hours)**

3.1 Automorphisms (K1, K2, K3)
3.2 Inner automorphisms (K1, K2, K3)
3.3 Cayley's theorem (K1, K2, K3)
3.4 Permutation groups (K1, K2, K3)
3.5 Cycles and Transpositions (K1, K2, K3, K4)
3.6 Even and odd permutations (K1, K2, K3, K4)
(Chapter 2: Section 2.8, 2.9, 2.10)

Unit IV: Ring Theory **(18 hours)**

4.1 Definition of a ring (K1, K2)
4.2 Examples of rings (K1, K2, K3)
4.3 Some special classes of rings (K1, K2)
4.4 Integral domain (K1, K2, K3, K4)
4.5 Homomorphisms and isomorphisms (K1, K2, K3, K4)
4.6 Ideals and Quotients Rings. (K1, K2, K3, K4)
(Chapter 3: Section 3.1, 3.2, 3.3, 3.4)

Unit V: Ring Theory (Contd.) **(18 hours)**

5.1 More Ideals and Maximal Ideals (K1, K2, K3)
5.2 Quotient Rings (K1, K2, K3)
5.3 The field of Quotients of an Integral Domain (K1, K2, K3, K4)
5.4 Euclidean Rings (K1, K2, K3)
5.5 Unique Factorisation Theorem (K1, K2, K3)
5.6 A particular Euclidean Ring (K1, K2, K3, K4)
(Chapter 3: Section 3.5, 3.6, 3.7, 3.8)

Text Book:

1. I.N. Herstein – Topics in Algebra – John Wiley & Sons, Inc, Second Edition, 2006

Reference Books:

1. S. Arumugam and A. Thangapandi Issac – Modern Algebra - Scitech Publications (India) Pvt. Ltd., 3rd Edition, Reprint, 2005.

2. S.G. Venkatachalapathy – Modern Algebra – Margham Publications, 2003.

3. M.L.Santiago -Modern Algebra, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2002.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – V
UCMAJ20 – Real Analysis I

Year: III **SEM:** V	**Course Code:** UCMAJ20	**Title of the Course:** Real Analysis – I	**Course Type:** Theory	**Course Category:** Core	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To create an interest and to deepen the knowledge of students in concepts of real analysis.
2. To familiarize the students to concepts of sequences, limits of sequences, limits of functions and continuity.
3. To introduce the concepts of convergent, divergent and bounded sets.

Course Outcomes (CO)

The learners will be able to

1. Know the basic properties of the real line and real number system.
2. Understand the fundamentals of sequences and to calculate their limits.
3. Recognize the arithmetic properties of convergence and divergence of sequence and series.
4. Learn the properties of metric space and its type.
5. Know about continuous function and its reformulation.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	L
CO2	H	H	M	M	H	L
CO3	H	M	H	H	H	L
CO4	H	M	H	H	H	L
CO5	H	H	H	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Functions and Real Numbers **(18 hours)**

1.1 Functions (K1, K2)
1.2 Real valued functions (K1, K2, K3, K4)
1.3 Equivalence – Countability (K1, K2, K3, K4)
1.4 Real Numbers (K1, K2)
1.5 Lease upper bounds (K1, K2, K3, K4)
1.6 Simple problems. (K1, K2, K3, K4)
(Chapter 1: Sections 1.3, 1.4, 1.5, 1.6, 1.7)

Unit II: Sequences of Real numbers **(18 hours)**

2.1 Definition of sequence and subsequence (K1, K2)
2.2 Limit of sequence (K1, K2, K3, K4)
2.3 Convergent sequences (K1, K2, K3, K4)
2.4 Divergent sequence (K1, K2, K3, K4)
2.5 Bounded sequences (K1, K2, K3, K4)
2.6 Monotone sequences – Simple problems (K1, K2, K3, K4)
(Chapter 2: Sections 2.1, 2.2, 2.3, 2.4, 2.5, 2.6)

Unit III: Sequences (continued) and Series of Real Numbers **(18 hours)**

3.1 Operations on convergent sequences (K1, K2, K3, K4)
3.2 Operations on divergent sequences (K1, K2, K3, K4)
3.3 Convergence and divergence of Series (K1, K2, K3, K4)
3.4 Series with non-negative terms (K1, K2, K3, K4)
3.5 Alternating series (K1, K2, K3, K4)
3.6 Simple problems (K1, K2, K3)
(Chapter 2: Sections 2.7, 2.8, Chapter 3: 3.1, 3.2, 3.3)

Unit IV: Limits and Continuity of Metric Spaces **(18 hours)**

4.1 Conditional convergence and absolute convergence (K1, K2, K3, K4)
4.2 Limits and continuity of metric space (K1, K2, K3, K4)
4.3 Limit of a function on the real line (K1, K2, K3, K4)
4.4 Metric spaces (K1, K2, K3, K4)
4.5 Limits in metric spaces (K1, K2, K3, K4)
4.6 Simple problems (K1, K2, K3)
(Chapter 3: Section 3.4; Chapter 4: Section 4.1, 4.2, 4.3)

Unit V: Continuous Functions on Metric Spaces **(18 hours)**

5.1 Functions continuous at a point on the real line (K1, K2, K3, K4)
5.2 Theorems on continuous function (K1, K2, K3, K4)
5.3 Reformulation (K1, K2, K3, K4)
5.4 Simple problems (K1, K2, K3, K4)
5.5 Functions continuous on metric space (K1, K2, K3)
5.6 Theorems on continuity of metric space (K1, K2, K3, K4)
(Chapter 5: Sections 5.1, 5.2, 5.3)

Text Book:

1. Richard R. Goldberg – Methods of Real Analysis – Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Indian Edition, 1970.

Reference Books:

1. Tom M,.Apostol - Mathematics Analysis , 2nd Edition – Narosa Publishing House – 1997.

2. Dr. K. ChandrasekarRao, Dr. K.S. Narayanan – Real Analysis Valume II, 2nd Edition – Viswanathan Publishers, 2008.

3. D. Somasundaram and B. Choudhray – A First Course in Mathematical Analysis, 1st Edition – Narosa Publishing House, 1999.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – V
UCMAK20 – Complex Analysis

Year: III **SEM:** V	**Course Code:** UCMAK20	**Title of the Course:** Complex Analysis	**Course Type:** Theory	**Course Category:** Core	**H/W** 6	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To introduce the fundamental ideas of the functions of complex variable
2. To impart the basic knowledge of holomorphic functions, Cauchy's integral formula and the residue theorem.

Course Outcomes (CO)

The learners will be able to

1. Know to define and give some of the important properties of complex analytic functions.
2. Learn certain elementary functions with special reference to the correspondence between certain portions of the z-plane and w-plane as determined by the relation between the function w and the independent variable z.
3. Become familiar with the integrals of analytic functions where many properties from calculus is carried over to complex case.
4. Expand the concept of sequence and series which plays a major part of calculus to the complex domain.
5. Learn to compute residues, which allow the determination of general contour integrals.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	H	L
CO2	H	M	L	H	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	H	L
CO5	H	L	M	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Analytic Functions **(18 hours)**

1.1 Regions in the Complex Plane (K1, K2)
1.2 Limits (K1, K2)
1.3 Theorems on limits (K1, K2, K3)
1.4 Continuity (K1, K2, K3)
1.5 Derivatives (K1, K2, K3)
1.6 C-R Equations (K1, K2, K3, K4)
(Chapter 1: Section: 8, Chapter: 2 Section: 11-17)

Unit II: Mappings by Elementary Functions **(18 hours)**

2.1 Mapping (K1, K2)
2.2 Bilinear transformations (K1, K2)
2.3 Cross-Ratio -Theorems and problems (K1, K2, K3, K4)
2.4 Linear Transformation$w = \frac{1}{z}$, problems (K1, K2, K3, K4)
2.5 Transformation$W = \sqrt{z}\,, W = e^z, W = sinz$ and $W = cosz$ (K1, K2, K3, K4)
2.6 Linear fractional transformations – An Implicit Form (K1, K2)
(Chapter 8: Sections: 68-71, 73-75)

Unit III: Complex Integration **(18 hours)**

3.1Definite integrals, Line and Contour Integrals – Examples (K1, K2)
3.2 Cauchy's Theorem Cauchy – Goursat Theorem (K1, K2, K3)
3.3 Cauchy integral formula (K1, K2, K3)
3.4 Derivatives of analytic functions – Morera's Theorem (K1, K2, K3)
3.5 Cauchy's in-equality (K1, K2, K3)
3.6 Liouville's theorem and the Fundamental theorem of algebra (K1, K2, K3,K4)
(Chapter: 4, Sections: 32, 33, 36-41, omit 39)

Unit IV: Series **(18 hours)**

4.1 Convergence of sequence and series (K1, K2)
4.2 Convergence of series (K1, K2)
4.3 Taylor series – Examples (K1, K2, K3)
4.4 Laurent series – Examples (K1, K2, K3, K4)
4.5 Absolute and uniform convergence of power series (K1, K2, K3, K4)
4.6 uniform convergence of power series (K1, K2, K3, K4)
(Chapter 5: Sections: 43-48)

Unit V: Residues and Poles **(18 hours)**

5.1 Zeros of analytic functions (K1, K2)
5.2 Singularities, Types of Singularities (K1, K2)
5.3 Theorem Riemann's Theorem – Weistrass (K1, K2, K3)
5.4 Residues – Residue theorems (K1, K2, K3, K4)
5.5 Residues at poles – Zeros and poles of order m (K1, K2, K3, K4)
5.6 Two types of integrals involving Sines and Cosines (K1, K2, K3, K4)
(Chapter 6: Sections: 53-57)

Text Book:

1. R. V.Churchill and J.W. Brown- Complex Variables and Applications- Mc Graw Hill Publishing Company, New york, 6th Edition, 1996.

Reference Books:

1. P. Duraipandian & Lakshmi Durai Pandian- Complex Analysis, The National publishing Co., 1980, Reprint 2001.
2. S. Narayanan & Manicavachagom Pillay- Complex Analysis, S.V. Publications, 3rd Edition. 1985.
3. J.N. Sharma - Functions of a Complex Variable - Krishna Prakashan Mandir, Meerut, U.P. Revised Edition 1978.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – V
UEMAA20 – Programming in C

Year: III **SEM:** V	**Course Code:** UEMAA20	**Title of the Course:** Elective-I A: Programming in C	**Course Type:** Theory	**Course Category:** Core Elective	**H/W** 4	**CREDITS** 3	**HOURS** 100

Course Objectives

1. To introduce students to the concept of basic programming, thereby enhancing the logical thinking of the students with regard to programming.
2. To train the students to apply the programming concepts of C to mathematical investigations and problem solving.
3. To enhance the ability of students to work independently and do in-depth study of various notions of programming.

Course Outcomes (CO)

The learners will be able to

1. Understand the basics of programming in C such as tokens, data types, operators etc.
2. Use the Decision making-branching and looping statements in C programming.
3. Handle the concept of arrays and the concept of the user defined functions.
4. Express the uses of structures and pointers
5. Understand and apply the programming concepts of C to problem solving.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Overview of C, Constants, Variables and Data types (12 hours)

1.1 Basic Structure of C programs – Character set (K1, K2)
1.2 C tokens – Keywords and Identifiers (K1, K2, K3, K4)
1.3 Constants – Variables (K1, K2, K3, K4)
1.4 Data types – Declaration of variables (K1,K2,K3,K4)
1.5 Assigning values to variables (K1, K2, K3, K4)
1.6 Defining symbolic constants – Declaring a variable as constant (K1, K2, K3, K4)
(Chapter 2: Sections 2.8; Chapter 3: Sections 3.2 – 3.8, 3.10 – 3.12)

Unit II: Operators, Expressions, Managing Input and Output Operations (12 hours)

2.1 Introduction-Arithmetic Operators-Relational Operators-Logical Operators (K1, K2, K3, K4)
2.2 Assignment Operators - Increment and Decrement Operators (K1, K2, K3, K4)
2.3 Conditional Operators - Bitwise Operators – Special Operators (K1, K2, K3, K4)
2.4 Arithmetic Expression-Evaluation of Expression-Precedence of Arithmetic Operators (K1, K2, K3, K4)
2.5 Type Conversions in Expressions – Operator Precedence and Associativity (K1, K2, K3, K4)
2.6 Reading a Character-Writing a Character-Formatted Input-Formatted Output (K1, K2, K3, K4)
(Chapter 4: Sections 4.1- 4.12, 4.14, 4.15; Chapter 5: Sections 5.2 – 5.5)

Unit III: Decision Making and Branching, Decision Making and Looping (12 hours)

3.1 Introduction - Decision Making with IF Statement (K1, K2, K3, K4)
3.2 Simple IF – IF ELSE - Nesting of IF ELSE statements (K1, K2, K3, K4)
3.3 The ELSE IF Ladder - The SWITCH statement (K1, K2, K3, K4)
3.4 The conditional (? :) operator- The GOTO statement (K1, K2, K3, K4)
3.5 Introduction - The WHILE statement – The DO statement (K1, K2, K3, K4)
3.6 The FOR statement - Jumps in LOOPS (K1, K2, K3, K4)
(Chapter 6: Sections 6.1 – 6. 9; Chapter 7: Sections 7.1 – 7.5.)

Unit IV: Arrays and User-Defined Functions (12 hours)

4.1 Introduction – One Dimensional Array (K1, K2, K3, K4)
4.2 Declaration and Initialization of One Dimensional Array (K1, K2, K3, K4)
4.3 Two Dimensional Arrays - Initializing Two Dimensional Arrays – Multi Dimensional Arrays (K1, K2, K3, K4)
4.4 Introduction – Need for User-defined functions – A Multi-function Program (K1, K2, K3, K4)
4.5 Elements of user-defined functions – Definition of functions – Return values and their types (K1, K2, K3, K4)
4.6 Function calls – Function declaration - Nesting of functions – Recursion. (K1, K2, K3, K4)
(Chapter 8: Sections 8.1- 8.7; Chapter 10: Sections 10.1 – 10.8, 10. 15, 10.16)

Unit V: Structures and Unions, Pointers (12 hours)

5.1 Introduction-Defining a structure-Declaring structure variables-Accessing structure members (K1, K2, K3, K4)
5.2 Structure initialization-copying and comparing structure variables-Operations on individual members (K1, K2, K3, K4)
5.3 Arrays of structures - Arrays within Structures - Structureswithin Structures - Unions (K1, K2, K3, K4)
5.4 Understanding Pointers – Accessing the address of a variable – Declaring pointer variables (K1, K2, K3, K4)
5.5 Initialization of pointer variables-Accessing a variable through its pointer-Chain of pointers (K1, K2, K3, K4)
5.6 Pointer expressions-Pointer increments and scale factor-Pointers and Arrays (K1, K2, K3, K4)
(Chapter 11: Sections 11. 1 - 11. 10, 11.12; Chapter 12: Sections 12. 2 – 12. 10.)

Text Book:

1. E. Balagurusamy, Programming in ANSI C, 8th Edition, McGraw Hill Education Private Limited, New Delhi, India, 2019.

Reference Book:

1. Ashok N. Kamathne, Programming with C, Pearson Publication, 2009.
2. C: The Complete Reference, Herb Schildt, 4th Edition, Tata McGraw Hill Publishers, 2017
3. Let Us C: Authentic guide to C programming language, Yashavant Kanetkar, (18th Edition), BPB Publications, 2021

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – V
UEMAB20 - Elective Practical I: C

Year: III **SEM:** V	**Course Code:** UEMAB20	**Title of the Course:** Elective Practical I : C	**Course Type:** Theory	**Course Category:** Elective	**H/W** 2	**CREDITS** 2	**HOURS** 100

Course Objectives

1. To introduce students to the concept of basic programming, thereby enhancing the logical thinking of the students with regard to programming.
2. To train the students to apply the programming concepts of C to mathematical investigations and problem solving.
3. To construct the ability of students to work independently and do in-depth study of various notions of programming.

Course Outcomes (CO)

The learners will be able to

1. Implement programs with branching and looping statements.
2. Write programs that perform operations using derived data types and functions.
3. Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
4. Perform Matrix operations using C.
5. Use structures and pointers in C programs.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	H	H
CO5	H	M	H	H	L	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

1. Simple Programs:

a) Sum of 'n' natural numbers.
b) Quadratic Equation
c) Simple Interest
d) Mean, Standard deviation and Variance.
e) Generating Prime numbers.
f) Largest of three numbers.

2. Summation of Series:

a) Sin(x)
b) Cos(x)

3. Recursion:

a) nPr and nCr
b) GCD of two numbers.

4. Matrix Manipulation:

a) Addition and Subtraction
b) Transpose.

5. Sorting and Searching:

a) Bubble sort (simple program)
b) Binary search and Median

6. Structures:

Grades of students of a class using structure

Text Book:

1. E. Balagurusamy, Programming in ANSI C, 4th Edition, Tata McGraw – Hill Education Private Ltd. New Delhi, India, 2008.

Reference Books:

1. Ashok N. Kamathne –Programming with C- Pearson publication, 2009.
2. C: The Complete Reference, Herb Schildt, 4th Edition, Tata McGraw Hill Publishers, 2017
3. Let Us C: Authentic guide to C programming language, Yashavant Kanetkar, (18th Edition), BPB Publications, 2021

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER - V
UEMAC20 - Number Theory

Year: III **SEM:** V	**Course Code:** UEMAC20	**Title of the Course:** Elective - I B: Number Theory	**Course Type:** Theory	**Course Category:** Core Elective	**H/W** 6	**CREDITS** 5	**HOURS** 100

Course Objectives

1. To introduce students to the concept of number theory, thereby enhancing the logical thinking of the students with regard to applications in security systems.
2. To construct the ability of students to work independently and do in-depth study of various notions of number theory.

Course Outcomes (CO)

The learners will be able to

1. Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences.
2. Learn about number theoretic functions, modular arithmetic and their applications.
3. Familiarize with modular arithmetic and find primitive roots of prime and composite numbers.
4. Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.
5. Apply public crypto systems, in particular, RSA.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	M	L
CO2	H	H	M	M	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	M	L
CO5	H	H	M	M	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Distribution of Primes and Theory of Congruencies (18 hours)

1.1 Linear Diophantine equation, Prime counting function (K1,K2)
1.2 Prime number theorem, Goldbach conjecture (K1,K2)
1.3 Twin-prime conjecture, Odd perfect numbers conjecture (K1,K2,K3)
1.4 Fermat and Mersenne primes, Congruence relation and its properties (K1, K2, K3, K4)
1.5 Linear congruence and Chinese remainder theorem (K1, K2, K3)
1.6 Fermat's little theorem, Wilson's theorem. (K1, K2, K3)

Unit II: Number Theoretic Functions (18 hours)

2.1 Number theoretic functions for sum and number of divisors (K1, K2, K3)
2.2 Multiplicative function (K1, K2)
2.3 The Möbius inversion formula (K1, K2)
2.4 Greatest integer function (K1, K2)
2.5 Euler's phi-function and properties (K1, K2, K3, K4)
2.6 Euler's theorem. (K1, K2)

Unit III: Primitive Roots (18 hours)

3.1Order of an integer modulo n (K1, K2)
3.2 Primitive roots for primes (K1, K2, K3)
3.3Composite numbers having primitive roots (K1, K2, K3)
3.4 Definition of quadratic residue of an odd prime (K1, K2)
3.5 Euler's criterion (K1, K2)
3.6 Problems (K1, K2, K3, K4)

Unit IV: Quadratic Reciprocity Law (18 hours)

4.1The Legendre symbol and its properties (K1, K2)
4.1The Legendre symbol and its properties-problems (K1, K2, K3, K4)
4.2 Quadratic reciprocity (K1, K2)
4.4 Quadratic reciprocity – problems (K1, K2, K3, K4)
4.5 Quadratic congruencies with composite moduli (K1, K2, K3)
4.6 Quadratic congruencies with composite moduli –problems (K1, K2, K3, K4)

Unit-V: Applications (18 hours)

5.1 Public key encryption (K1, K2, K3, K4)
5.2 Public key encryption (continued) (K1, K2, K3, K4)
5.3 RSA encryption and decryption with applications in security systems (K1, K2, K3, K4)
5.4 RSA encryption and decryption with applications in security systems (K1, K2, K3, K4)
5.5 RSA encryption and decryption with applications in security systems (K1, K2, K3, K4)
5.6 RSA encryption and decryption with applications in security systems (K1, K2, K3, K4)

Text Book:

1. David M. Burton -Elementary Number Theory, 7th edition, McGraw-Hill., 2007.

Reference Books:

1. Gareth A. Jones & J. Mary Jones -Elementary Number Theory. Springer, 2005.
2. Neville Robbins - Beginning Number Theory, 2nd edition, Narosa, 2007.
3. I.Niven - An Introduction to the Theory of Numbers, 5th edition, John Wiley & Sons, 2012.
4. 5. Neal Koblitz - A Course in Number Theory and Cryptography, 2nd edition, Springer-Verlag. 1994.

e- Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – V

USMAC20 – Mathematics for Competitive Examinations

Year: III **SEM:** V	**Course Code:** USMAC20	**Title of the Course:** Mathematics for Competitive Examinations	**Course Type:** Theory	**Course Category:** Skill Based Elective	**H/W** 2	**CREDITS** 2	**MARKS** 100

Course Objectives

1. To improve the numerical ability and logical thinking of the students.
2. To prepare the students for various competitive examinations.

Course Outcomes (CO)

The learners will be able to

1. Apply the concepts of average, percentage, ratio and proportion to solve real life problems.
2. Think critically and solve problems.
3. Improve their creative thinking and make decisions in real life situations.
4. Determine the number of possible outcomes in a problem and calculate the probability of events for more complex outcomes.
5. Analyse and compare the given data to use analytic techniques that are simple and effective to solve problems.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	M	H	L
CO2	H	H	H	M	H	L
CO3	M	M	H	H	H	L
CO4	H	M	H	H	H	L
CO5	H	H	M	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Arithmetical Ability **(6 hours)**

Number system, Progression, Average, Ratio and Proportion (K1, K2, K3, K4)

Unit II: Arithmetical Ability (Continued) **(6 hours)**

Percentage, Profit and Loss, Interest, Time and Work, Time, Speed and Distance, Work and Wages (K1, K2, K3, K4)

Unit III: Arithmetical Ability (Continued) **(6 hours)**

Ages, Boats and Streams, Clocks and Calendar, Logarithms, Simplifications, Height and Distance (K1, K2, K3, K4)

Unit IV: Probability **(6 hours)**

Permutations and Combinations, Probability (K1, K2, K3, K4)

Unit V: Data Interpretation **(6 hours)**

Tabulation, Bar graph, Pie chart, Line graph (K1, K2, K3, K4)

Text Book:

1. Dr. R.S. Aggarwal, Quantitative Aptitude, S. Chand Publication, Revised Edition, Year 2018.

Reference Books:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, McGraw Education Series, 5th Edition 2019

2. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, Pearson India, Edition 2019.

3. Sarvesh K. Verma, Quantitative Aptitude Quantum CAT 2018, Arihant publication, Edition 2018.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. www.indiabix.com

SEMESTER – VI
UCMAL20 – Linear Algebra

Year : III SEM : VI	Course Code : UCMAL20	Title Of The Course : Linear Algebra	Course Type : Theory	Course Category: Core	H/W 6	CREDITS 6	MARKS 100

Course Objectives

1. To introduce the concepts of linear algebra.
2. To familiarize the concepts of linear transformation and their matrices.

Course Outcomes (CO)

The learners will be able to

1. Understand the concepts of basis, linear dependence and independence.
2. Analyze the concepts of dual spaces in vector space and inner product space.
3. Understand the concepts of linear transformation, characteristic roots and characteristic vectors.
4. Obtain the matrix for linear transformations.
5. Acquire knowledge about determinants, trace and transpose by linear transformations.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I Vector Spaces **(18 hours)**

1.1 Definition and examples of vector spaces (K1, K2, K3)
1.2 Subspaces and homomorphisms (K1, K2, K3,)
1.3 Quotient Spaces, Internal and External direct sum (K1, K2, K3, K4)
1.4 Linear span, Linear independence (K1, K2, K3)
1.5 Basis, Properties of basis (K1, K2, K3)
1.6 Dimensions of a vector space. (K1, K2, K3, K4)
(Chapter 4: Sections 4.1, 4.2)

Unit II: Vector Spaces (Continued) **(18 hours)**

2.1 Dual Spaces – Hom (V, W), Hom (V,V) and Hom (V,F) (K1, K2, K3)
2.2 Definition and examples of Inner Product Spaces (K1, K2, K3)
2.3 Norm of a vector and Schwarz inequality (K1, K2, K3)
2.4 Orthogonal vectors and Orthogonal complement (K1, K2,)
2.5 Orthonormal sets (K1, K2, K3)
2.6 Gram-Schmidt orthogonalization process. (K1, K2, K3, K4)
(Chapter 4: Sections 4.3, 4.4)

Unit III: Linear Transformations **(18 hours)**

3.1 Definition of algebra and linear transformations (K1, K2,)
3.2 Minimal polynomial for linear transformations (K1, K2, K3)
3.3 Regular and Singular linear transformations (K1, K2, K3)
3.4 Range and rank of a linear transformation (K1, K2, K3)
3.5 Characteristic roots of a linear transformation (K1, K2, K3)
3.6 Characteristic vectors (K1, K2, K3, K4)
(Chapter 6: Sections 6.1, 6.2)

Unit IV Linear Transformations (Continued) **(18 hours)**

4.1 Definition of matrix of a linear transformation (K1, K2,)
4.2 Computation of matrices of linear transformation (K1, K2, K3, K4)
4.2 Isomorphism of A(V) onto F_n (K1, K2, K3)
4.3 Computation of the matrix of linear transformations from a known basis (K1, K2, K3, K4)
4.4 Similar linear transformations (K1, K2, K3)
4.5 Triangular form (K1, K2, K3, K4)
(Chapter 6: Sections 6.3, 6.4)

Unit V Linear Transformations (Contd.) **(18 hours)**

5.1 Trace of a matrix and properties (K1, K2)
5.2 Trace of a linear transformation (K1, K2, K3)
5.3 Transpose of a matrix and properties (K1, K2, K3)
5.4 Determinants – definition and properties (K1, K2, K3)
5.5 Cramer's Rule (K3, K4)
5.6 Cayley-Hamilton theorem (K3, K4)
(Chapter 6: Sections 6.8, 6.9)

Text Book:

1. I.N. Herstein – Topics in Algebra – John Wiley & Sons, Inc, Second Edition, 2006

Reference Books:

1. J.N. Sharma and A.R. Vashistha – Linear Algebra, Krishna Prakash Nanda, 1981.

2. Lloyd R.Jaisingh, Frank Ayres – Abstract Algebra - Schaum's outlines – Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

3. M.L.Santiago – Modern Algebra, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – VI
UCMAM20 – Real Analysis II

Year: III **SEM:** VI	**Course Code:** UCMAM20	**Title of the Course:** Real Analysis-II	**Course Type:** Theory	**Course Category:** Core	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To create an interest and to deepen the knowledge of students in concepts of real analysis.
2. To make the students think logically and objectively.
3. To make the students understand the difference between the Riemann and Lebesque integrability.

Course Outcomes (CO)

The learners will be able to

1. Understand some properties of metric spaces like openness, closedness, boundedness and totally boundedness.
2. Know the fundamental concepts of complete and compact metric space.
3. Apply the properties of Riemann integrable functions.
4. Assimilate the concept of partition on an interval in R and understand about lebesgue integrability.
5. Acquire knowledge about measurable functions and their properties.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	M	M	L
CO2	H	H	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Connectedness and Completeness **(18 hours)**

1.1 Open sets (K1, K2)
1.2 Closed sets (K1, K2)
1.3 Simple problems based on open and closed sets. (K1, K2, K3)
1.4 Theorems on open sets and closed sets (K1, K2, K3, K4)
1.5 Bounded sets (K1, K2, K3, K4)
1.6 Totally bounded sets (K1, K2, K3, K4)
(Chapter 5 – 5.4, 5.5, Chapter 6 – Sections 6.3)

Unit II: Compactness and Continuity **(18 hours)**

2.1 Definition of Complete metric space (K1, K2)
2.2 Examples of Complete metric space (K1, K2, K3)
2.3 Theorems on Complete metric space (K1, K2, K3, K4)
2.4 Contraction (K1, K2, K3, K4)
2.5 Definition and example of Compact metric spaces (K1, K2, K3)
2.6 Theorems on Compact metric space (K1, K2, K3, K4)
(Chapter 6 – Section 6.4, 6.5)

Unit III: The Riemann Integral **(18 hours)**

3.1 Sets of measure zero (K1, K2, K3, K4)
3.2 Definition of the Riemann integral (K1, K2)
3.3 Definition of Riemann upper sum and lower sum (K1, K2)
3.4 Properties of the Riemann integral. (K1, K2, K3, K4)
3.5 Theorems on Riemann integral (K1, K2, K3, K4)
3.6 Simple problems (K1, K2, K3)
(Chapter 7 – Sections 7.1, 7.2, 7.4)

Unit IV: The Lebesgue Integral **(18 hours)**

4.1 Length of open sets and closed sets (K1, K2, K3, K4)
4.2 Inner and Outer measure (K1, K2, K3, K4)
4.3 Measurable sets (K1, K2)
4.4 Properties of measurable sets. (K1, K2, K3, K4)
4.5 Theorems on measurable sets (K1, K2, K3, K4)
4.6 Symmetric difference and its theorem (K1, K2, K3, K4)
(Chapter 11 – Sections 11.1, 11.2, 11.3)

Unit V: The Lebesgue Integral (Continued) **(18 hours)**

5.1 Definition and example of Measurable functions (K1, K2, K3)
5.2 Theorems on measurable functions (K1, K2, K3, K4)
5.3 Definition and existence of the Lebesgue integral for bounded function (K1, K2, K3, K4)
5.4 Theorems on Lebesgue integral (K1, K2, K3, K4)
5.5 Properties of the Lebesgue integral for bounded measurable functions. (K1, K2, K3, K4)
5.6 Relationship between Riemann and Lebesgue integral (K1, K2, K3, K4)
(Chapter 11 – Sections 11.4, 11.5, 11.6)

Text Book:

1. Richard R.Goldberg – Methods of Real Analysis – Oxford & IBH Publishing Co. Pvt., Ltd., New Delhi, Indian Edition, 1970.

Reference Book:

1. Tom M,.Apostol - Mathematics Analysis , 2nd Edition – Narosa Publishing House – 1997.

2. Dr. K. ChandrasekarRao, Dr. K.S. Narayanan – Real Analysis Valume II, 2nd Edition – Viswanathan Publishers, 2008.

3. D. Somasundaram and B. Choudhray – A First Course in Mathematical Analysis, 1st Edition – Narosa Publishing House, 1999.

e- Resources

4. https://nptel.ac.in
5. www.coursera.org
6. https://swayam.gov.in/

SEMESTER – VI
UEMAD20 – Graph Theory

Year : III **SEM :** VI	**Course Code:** UEMAD20	**Title Of The Course:** Elective - II A**:** Graph Theory	**Course Type:** Theory	**Course Category:** Elective	**H/W** 6	**Credits** 5	**Marks** 100

Course Objectives

1. To introduce the students to the beautiful and elegant theory of graphs.
2. To study and develop the concepts of different graphs

Course Outcomes (CO)

The learners will be able to

1. Understand the basic graph theory concepts
2. Analyse the connectedness in graphs using vertices and edges.
3. Identify the uniqueness of paths using tree concepts.
4. Acquire wide knowledge of mathematical principles of graphs
5. Understand the emerging research topics based on graphs

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	H	L
CO2	H	H	H	M	L	H
CO3	H	H	H	H	H	M
CO4	H	H	M	L	H	H
CO5	H	H	M	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Graphs and Subgraphs **(18 hours)**

1.1 Introduction to Graphs- subgraphs (K1,K2)
1.2 Degree of a vertex (K1,K2, K3, K4)
1.3 Isomorphism of graphs (K1,K2, K3, K4)
1.4 Independent sets and coverings(simple theorems) (K1,K2, K3, K4)
1.5 Intersection graphs and line graphs (definition and examples) (K1,K2, K3, K4)
1.6 Operations on graphs. (K1,K2, K3, K4)

Unit II: Connectedness and components **(18 hours)**

2.1 Walks, Trails and Paths (problems and simple theorems) (K1, K2, K3, K4)
2.2 Connectedness and components - cut point (problems and simple theorems) (K1, K2, K3, K4)
2.3 Bridge (problems and simple theorems) (K1, K2, K3, K4)
2.4 Block (problems and simple theorems) (K1, K2, K3, K4)
2.5 Vertex Connectivity (K1, K2, K3, K4)
2.6 Edge Connectivity(K1, K2, K3, K4)

Unit III: Trees **(18 hours)**

3.1 Tree – Introduction (K1, K2)
3.2 Forest (K1, K2)
3.3 Equivalent property of tree (K1, K2, K3, K4)
3.4 Spanning tree (K1, K2, K3, K4)
3.5 Centre of a tree (K1, K2, K3, K4)
3.6 Results in Centre of a tree (K1, K2, K3, K4)

Unit IV: Eulerian and Hamiltonian Graphs **(18 hours)**

4.1 Eulerian graphs (K1, K2, K3, K4)
4.2 Equivalent property of Eulerian graphs (K1, K2, K3, K4)
4.3 Hamiltonian graphs (K1, K2, K3, K4)
4.4 Property of Hamiltonian graphs (K1, K2, K3, K4)
4.5 Simple problems in Hamiltonian graphs (K1, K2, K3, K4)
4.6 Algorithm (K1, K2, K3, K4)

Unit V - Planarity and colourability **(18 hours)**

5.1 Planarity-definition (K1, K2)
5.2 Planarity properties (K1, K2, K3, K4)
5.3 Characterisation of planar graph (K1, K2, K3, K4)
5.4 Colourability (K1, K2, K3, K4)
5.5 Chromatic number (K1, K2, K3, K4)
5.6 Index (K1, K2, K3, K4)

Text Books:

1. S. Arumugam and S. Ramachandran, Invitation to Graph Theory, SITECH Publications, India Pvt. Ltd., 2006

2. J.A.Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillon, London, 2008.

Reference Books:

1. S.Kumaravelu, Susheela Kumaravelu, Graph Theory, SKV Publishers, Sivakasi, 1999.

2. S.A.Choudham, A First Course in Graph Theory, Macmillan India Ltd, 2000.

3. Robin J. Wilson, Introduction to Graph Theory, Prentice Hall, 2012.

4. Harray, Graph Theory, Narosa Publication, 1998.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – VI
UEMAE20 - Discrete Mathematics

Year: III **SEM:** VI	**Course Code:** UEMAE20	**Title of the Course:** Elective - II B: Discrete Mathematics	**Course Type:** Theory	**Course Category:** Core Elective	**H/W** 6	**CREDITS** 5	**HOURS** 100

Course Objectives

1. To introduce students to the concept of basic discrete mathematics, thereby enhancing the logical thinking of the students with regard to discrete domain.
2. To train the students in the applications of the discrete mathematical structures.
3. To construct the ability of students to work independently and do in-depth study of various notions of discrete mathematics.

Course Outcomes (CO)

The learners will be able to

1. Learn about partially ordered sets.
2. Understand lattices and their types.
3. Understand Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.
4. Solve real-life problems using finite-state and Turing machines.
5. Assimilate various graph theoretic concepts and familiarize with their applications.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	M	M	L
CO2	H	H	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Partially Ordered Sets (18 hours)

1.1 Definitions, examples and basic properties of partially ordered sets (poset) (K1,K2)
1.2 Order isomorphism, Hasse diagrams (K1, K2, K3, K4)
1.3 Dual of a poset, Duality principle (K1, K2, K3)
1.4 Maximal and minimal elements (K1, K2, K3)
1.5 Least upper bound and greatest upper bound (K1, K2, K3)
1.6 Building new poset, Maps between posets (K1, K2, K3, K4)

Unit II: Lattices (18 hours)

2.1 Lattices as posets (K1, K2, K3)
2.2 Lattices as algebraic structures (K1, K2, K3)
2.3 Sub lattices (K1, K2)
2.4 Products and homomorphisms – Definitions and examples (K1, K2, K3, K4)
2.5 Properties of modular and distributive lattices (K1, K2)
2.6 Complemented, relatively complemented and sectionally complemented lattices (K1, K2)

Unit III: Boolean Algebras and Switching Circuits (18 hours)

3.1 Boolean algebras, De Morgan's laws (K1, K2)
3.2 Boolean homomorphism, Representation theorem (K1, K2)
3.3 Boolean polynomials, Boolean polynomial functions (K1, K2, K3)
3.4 Disjunctive and conjunctive normal forms (K1, K2)
3.5 Minimal forms of Boolean polynomials (K1, K2, K3)
3.6 Quine-McCluskey method, Karnaugh diagrams, Switching circuits(K1, K2, K3, K4)

Unit IV: Finite-State and Turing Machines (18 hours)

4.1 Finite-state machines with outputs (K1, K2, K3)
4.2 Finite-state machines with no output (K1, K2, K3)
4.3 Deterministic finite-state automaton (K1, K2, K3)
4.4 Nondeterministic finite-state automaton (K1, K2, K3)
4.5 Turing machines – Definitions (K1, K2)
4.6 Turing machines - examples and computations (K1, K2, K3, K4)

Unit V: Graphs (18 hours)

5.1 Definition, examples and basic properties of graphs (K1, K2)
5.2 Königsberg bridge problem (K1, K2, K3)
5.3 Subgraphs – Pseudographs - Complete graphs - Bipartite graphs (K1, K2)
5.4 Isomorphism of graphs - Paths and circuits - Eulerian circuits - Hamiltonian cycles (K1, K2)
5.5 Adjacency matrix - Weighted graph - Travelling salesman problem (K1, K2, K3)

5.6 Shortest path and Dijkstra's algorithm (K1, K2, K3)

Text Books:

1. B. A. Davey & H. A. Priestley (2002). Introduction to Lattices and Order (2nd edition). Cambridge University Press.
2. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson Education.

Reference Books:

1. Rudolf Lidl & Günter Pilz (1998). Applied Abstract Algebra (2nd edition). Springer.

2. Kenneth H. Rosen (2012). Discrete Mathematics and its Applications**:** With Combinatorics and Graph Theory (7th edition). McGraw-Hill.

3. C. L. Liu (1985). Elements of Discrete Mathematics (2nd edition). McGraw-Hill.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

SEMESTER – VI

UEMAF20 - Object Oriented Programming Using C++

Year: III **SEM:** VI	**Course Code:** UEMAF20	**Title of the Course:** Elective - III: Object Oriented Programming Using C++	**Course Type:** Theory	**Course Category:** Core Elective	**H/W** 4	**CREDITS** 3	**HOURS** 100

Course Objectives

1. To introduce students to the concept of object oriented programming with C++, thereby enhancing the logical thinking of the students with regard to programming.
2. To train the students to apply the programming concepts of C++ to mathematical investigations and problem solving.
3. To construct the ability of students to work independently and do in-depth study of various notions of programming.

Course Outcomes (CO)

The learners will be able to

1. Understand the basics of programming in C++ such as tokens, data types, operators etc.
2. Use the Decision making-branching and looping statements in C++ programming.
3. Handle the concept of arrays and the concept of the user define functions.
4. Express the uses of structures and pointers.
5. Understand and apply the programming concepts of C to problem solving.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	M	H	M	H	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Principles of OOP and Introduction to C++, Tokens (12 hours)

1.1 Basic concepts of object oriented programming – Benefits of OOP (K1, K2)
1.2 Structure of C++ Program - Tokens - Keywords (K1, K2, K3, K4)
1.3 Identifiers and constants - Basic data types (K1, K2, K3, K4)
1.4 User defined data types - Derived data types (K1, K2, K3, K4)
1.5 Symbolic constants – Type compatibility - Declaration of variables (K1, K2, K3, K4)
1.6 Dynamic Initialization of variables – Reference variables (K1, K2, K3, K4)
(Chapter 1: Sections 1.5 -, 1.6; Chapter 2: Sections 2.6; Chapter 3: Sections 3.2 - 3.6, 3.8-3.13)

Unit II: Operators, Expressions and Control Structures (12 hours)

2.1 Operators in C++ - Scope Resolution Operator (K1, K2, K3, K4)
2.2 Member Dereferencing operators – Memory management operators (K1, K2, K3, K4)
2.3 Manipulators – Type cast operator (K1, K2, K3, K4)
2.4 Expressions and their types – Special assignment expressions (K1, K2, K3, K4)
2.5 Implicit conversions – Operator overloading (K1, K2, K3, K4)
2.6 Operator precedence – Control structures (K1, K2, K3, K4)
(Chapter 3: Sections 3.14 - 3. 25)

Unit III: Functions in C++, Classes and Objects (12 hours)

3.1 Introduction- Function prototyping-Call by reference-Return by reference (K1, K2, K3, K4)
3.2 Inline functions-Default arguments-const arguments-Function overloading (K1, K2, K3, K4)
3.3 Specifying a class-Defining member functions-A C++ program with class (K1, K2, K3, K4)
3.4 Making an outside function inline-Nesting of member functions -Private member functions (K1, K2, K3, K4)
3.5 Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects (K1, K2, K3, K4)
3.6 Objects as function arguments – Friendly functions – Returning objects – const member functions – Pointers to members (K1, K2, K3, K4)
(Chapter 4: Sections 4.1, 4.3 – 4. 8, 4.10; Chapter 5: Sections 5.3- 5.18.)

Unit IV: Constructors and Destructors, Operator Overloading (12 hours)

4.1 Introduction – Constructors (K1, K2, K3, K4)
4.2 Parameterized constructors – Multiple constructors in a class (K1, K2, K3, K4)
4.3 Constructors with default arguments – Copy constructor (K1, K2, K3, K4)
4.4 const objects – Destructors (K1, K2, K3, K4)
4.5 Defining operator overloading – Overloading unary operators – Overloading binary operators (K1, K2, K3, K4)
4.6 Overloading binary operators using friends-Rules for overloading operators (K1, K2, K3, K4)
(Chapter 6: Sections 6.1- 6.5, 6.7, 6.10, 6.11; Chapter 7: Sections 7.2 – 7.5, 7.8)

Unit V: Inheritance, Pointers, Managing console I/O Operations (12 hours)

5.1 Introduction – Defining derived classes – Single inheritance (K1, K2, K3, K4)
5.2 Making a private member inheritable – Multilevel inheritance (K1, K2, K3, K4)
5.3 Multiple inheritance – Hierarchical inheritance (K1, K2, K3, K4)
5.4 Hybrid inheritance – Virtual base classes – Abstract classes (K1, K2, K3, K4)
5.5 Pointers – Pointers to Objects – this pointer (K1, K2, K3, K4)
5.6 Introduction – C++ streams – C++ stream classes – Unformatted I/O Operations – Formatted console I/O operations – Managing output with manipulators (K1, K2, K3, K4)
(Chapter 8: Sections 8.1 – 8.10; Chapter 9: Sections 9.2 – 9. 4; Chapter 10: Sections 10.1– 10.6)

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, 7th Edition, McGraw Hill Education Private Ltd, New Delhi, India, 2018.

Reference Books:

1. Robert Lafore – Object Oriented Programming in Microsoft C++ - Galgotia Publication, Fourth Edition, 2009.
2. Herbert Schildt – The Complete Reference C++, Tata McGraw Hill Publication, 4th Edition, 2002.
3. Object Oriented Programming in C++, Robert Lafore, 4th Edition, Pearson Publications, 2008.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – VI
UEMAG20 - Elective Practical II: C++

Year: III **SEM:** VI	**Course Code:** UEMAG20	**Title of the Course:** Elective Practical II : C++	**Course Type:** Theory	**Course Category:** Elective	**H/W** 2	**CREDITS** 2	**HOURS** 100

Course Objectives

1. To introduce students to the concept of basic programming, thereby enhancing the logical thinking of the students with regard to programming.
2. To train the students to apply the programming concepts of C to mathematical investigations and problem solving.
3. To enhance the ability of students to work independently and do in-depth study of various notions of programming.

Course Outcomes (CO)

The learners will be able to

1. Implement programs with class and constructors.
2. Write programs that perform operations using derived data types and functions.
3. Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
4. Use inheritance properties that promote code reuse in C++.
5. Overload functions and operators in C++.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

1. Simple program using class and object.
2. Find largest of three numbers using all types of constructors.
3. Calculation of Mean and Standard Deviation.
4. Selection sort.
5. Product of matrices.
6. String manipulation.
7. Operator overloading (Unary)
8. Arrays of Object.
9. Function Overloading.
10. Implementing Inheritance. (Multiple)

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, 4th Edition, Tata McGraw – Hill Education Private Ltd. New Delhi, India, 2008.

Reference Books:

1. Robert Lafore – Object Oriented Programming in Microsoft C++ - Galgotia Publication, Fourth Edition, 2009.
2. Herbert Schildt – The Complete Reference C++, Tata McGraw Hill Publication, 4th Edition, 2002.
3. Object Oriented Programming in C++, Robert Lafore, 4th Edition, Pearson Publications, 2008.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – VI
USMAD20 - Fuzzy Set Theory

Year : III **SEM** : VI	**Course Code :** USMAD20	**Title Of The Course :** Fuzzy Set Theory	**Course Type :** Theory	**Course Category :** SBE	**H/W** 2	**CREDITS** 2	**MARKS** 100

Course Objectives

1. To explain the emergence of fuzzy set from an historical perspective.
2. To introduce the basic concepts of the existing research topic fuzzy sets.

Course Outcomes (CO)

The learners will be able to

1. Distinguish between classical crisp set and fuzzy set using characteristic function and membership function respectively.
2. Understand the operations on the fuzzy set which are generalization of crisp set operations.
3. Represent the notion of fuzzy relational equations based upon the max-min composition.
4. Model fuzzy graphs which provides provision to represent different types of relationships
5. Know about the fuzzy number which is a special form of a fuzzy set on the set of real numbers.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	L
CO2	H	H	M	M	H	L
CO3	H	H	M	H	H	L
CO4	H	H	H	H	H	L
CO5	H	H	L	M	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

UNIT I: Fuzzy Sets (6 hours)

Sets - Operation of Sets - Characteristics of Crisp Set - Definition of fuzzy set - Expanding concepts of fuzzy set - Standard Operation of Fuzzy Set (K1, K2, K3, K4)
(Chapter 1: Sections 1.1-1.6)

UNIT II: The Operation of Fuzzy Set (6 hours)

Standard operations of Fuzzy Set - Fuzzy Complement - Fuzzy Union - Fuzzy Intersection – Other Operations in Fuzzy Set - T-norms and T-conorms (K1, K2, K3, K4)
(Chapter 2: Sections 2.1-2.6)

UNIT III: Fuzzy Relation and Composition (6 hours)

Crisp relation - Properties of Relation on a Single Set - Fuzzy relation - Extension of fuzzy set (K1, K2, K3, K4)
(Chapter 3: Sections 3.1-3.4)

UNIT IV: Fuzzy Graph and Relation (6 hours)

Fuzzy Graph - Characteristics of fuzzy relation - Classification of fuzzy relation - Other Fuzzy Relations (K1, K2, K3, K4)
(Chapter 4: Sections 4.1 - 4.4)

UNIT V: Fuzzy Number (6 hours)

Concept of fuzzy number - Operation of fuzzy number - Triangular fuzzy number - Other types of fuzzy numbers (K1, K2, K3, K4)
(Chapter 5: Sections 5.1 – 5.4)

Text Book:

1. Kwang H. Lee - First course on Fuzzy Theory and Applications – Springer-Verlag Berlin Heidelberg, New York, 2005.

Reference Books:

1. George J. Klir and Bo Yuan -Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. Zimmerman H.J. - Fuzzy Set Theory and its Applications, Allied Publishers Ltd., Second Edition, 1996.

e- Resources

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in/

ASSESSMENT METHODS

1. For Core/Elective Papers

Semester Examination (100 Marks)
Time: 3 Hours

Section A – 10 x 2 = 20 marks
Answer **all** questions
10 questions (2 questions from each unit)

Section B – 5 x 7 = 35 marks
Answer **all** questions
5 questions with internal choice (1 question from each unit)

Section C – 3 x 15 = 45 marks
Answer **any three** questions
5 questions (1 question from each unit)

CA Examination (50 Marks)
Time: 1 Hour 30 Minutes

Section A – 7 x 2 = 14 marks
Answer **all** questions
7 questions

Section B – 3 x 7 = 21 marks
Answer **any three** questions
3 out of 5 questions

Section C– 1 x 15 = 15 marks
Answer **any one** question
2 questions (1 question from each unit)

2. For Elective Practical: C and C++

External Assessment (60 Marks)

Record – 10 marks
Viva – 5 marks
Semester Practical – 45 marks (Time: 3 Hours)

Internal Assessment (40 Marks)

Observation – 10 marks
Perfection – 5 marks
CA practical – 25 marks (Time: 1 Hour 30 Minutes)

3. For Skill Based Electives

For SBE III: Numerical Methods and SBE VI: Fuzzy Set Theory

Semester Examination (60 Marks)
Time: 2 Hours

Section A – 10 x 2 = 20 marks
Answer **all** questions

10 questions (2 questions from each unit)

Section B – 4 x 5 = 20 marks
Answer **any four** questions
5 questions (1 question from each unit)

Section C – 2 x 10 = 20 marks
Answer **any two** questions
5 questions (1 question from each unit)

CA Examination (30 Marks)
Time: 1 Hour

Section A – 5 x 2 = 10 marks
Answer **all** questions
5 questions

Section B – 2 x 5= 10 marks
Answer **any two** questions
4 questions (2 questions from each unit)

Section C – 1 x 10= 10 marks
Answer **any one** question
2 questions (1 question from each unit)

For SBE IV: R Programming Language

External Assessment (60 Marks)

Record – 10 marks
Viva – 5 marks
Semester Practical – 45 marks (Time: 2 Hours)

Internal Assessment (40 Marks)

Observation – 10 marks
Perfection – 5 Marks
CA Practical – 25 marks (Time: 1 Hour)

For SBE V: Mathematics for Competitive Examinations

Semester Examination (60 Marks)
Time: 2 Hours

60 multiple choice questions (1 mark for each question)

CA Examination (30 Marks)
Time: 1 Hour

30 multiple choice questions (1 mark for each question)

UG ALLIED PAPERS

SEMESTER – I
UCBAB20 – Business Mathematics and Statistics I

Year: I **SEM:** I	**Course Code:** UCBAB20	**Title of the Course:** Business Mathematics and Statistics - I	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To introduce mathematical applications in business and management, thereby enhancing the logical thinking of the students with regard to problem solving.
2. To train the students to apply statistical techniques in business and management, thereby enhancing the decision making skills of the students.

Course Outcomes (CO)

The learners will be able to

1. Apply the concept of matrices in solving business problems.
2. Analyze and demonstrate differentiation skills in economics and business.
3. Apply graphical methods to interpret statistical data.
4. Apply the statistical techniques in business.
5. Solve a range of problems using the techniques covered.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	M	L
CO2	H	H	H	H	M	L
CO3	H	H	M	H	M	L
CO4	H	H	L	H	M	H
CO5	H	M	H	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	L	H
CO4	H	H	M	L	M	H
CO5	H	H	M	L	M	H

(Low-L, Medium - M, High - H)

Course Syllabus

Unit I: Matrices **(15 hours)**

1.1.Definition, Types of matrices (K1, K2, K3, K4)
1.2 Matrix operations, Determinant of a matrix (K1, K2, K3, K4)
1.3 Singular and non-singular matrices(K1, K2, K3, K4)
1.4 Inverse of a matrix by co-factor method (K1, K2, K3, K4)
1.5 Rank of a matrix (K1, K2, K3, K4)
1.6 Solution of system of linear simultaneous equations using Cramer's rule (K1, K2, K3, K4)

Unit II: Differentiation **(15 hours)**

2.1 Differentiation (K1, K2, K3, K4)
2.2 Derivatives of standard functions x^n, e^x, log x, constant (without proof) (K1, K2, K3, K4)
2.3 Rules of differentiation (Addition, difference, product, quotient) (K1, K2, K3, K4)
2.4 Chain rule, Successive differentiation (up to second derivative) (K1, K2, K3, K4)

2.5 Uses: Marginal Concepts, Elasticity of demand, Increasing and decreasing functions (K1, K2, K3, K4)
2.6 Maxima and minima, break - even point. (K1, K2, K3, K4)

Unit III: Classification and Graphical Representation **(15 hours)**

3.1 Introduction, meaning of classification, chief characteristics of classification, objects of classification rules of classification (K1, K2, K3, K4)
3.2 Frequency distribution, individual observations (K1, K2, K3, K4)
3.3 Discrete frequency distributions continuous frequency distribution (K1, K2, K3, K4)
3.4 Frequency distribution, graph of frequency distribution (K1, K2, K3, K4)
3.5 Histogram (K1, K2, K3, K4)
3.6 Frequency polygon, frequency curve. (K1, K2, K3, K4)

Unit IV: Measures of Central Tendency **(15 hours)**

4.1 Arithmetic mean (K1, K2, K3, K4)
4.2 Median (K1, K2, K3, K4)
4.3 Mode (K1, K2, K3, K4)
4.4 Empirical formulae, Combined and Weighted arithmetic mean (K1, K2, K3, K4)
4.5 Geometric mean (K1, K2, K3, K4)
4.6 Harmonic mean. (K1, K2, K3, K4)

Unit V: Measures of Dispersion and Skewness **(15 hours)**

5.1 Range (K1, K2, K3, K4)
5.2 Quartile deviation (K1, K2, K3, K4)
5.3 Mean deviation (K1, K2, K3, K4)
5.4 Standard deviation (K1, K2, K3, K4)
5.5 Karl Pearson’s coefficient of skewness (K1, K2, K3, K4)
5.6 Bowley’s coefficient of skewness. (K1, K2, K3, K4)

Text Books:

1. P. A. Navnitham - Business Mathematics and Statistics - Jai Publishers - Trichy 2007.

2. R. S. N. Pillai and Bagavathi - Statistics, 17th Edition, S. Chand and Company - New Delhi, 1984.

Reference Books:

1. Francis, Andy - Business mathematics and statistics. Cengage Learning EMEA, 2004.

2. Agarwal, B. M. - Business Mathematics & Statistics. Ane Books Pvt Ltd, 2009.

3. Asim Kumar Manna - Business Mathematics & Statistics. McGraw Hill Education (India) Pvt. Ltd., 2018.

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – II
UCBAD20 - Business Mathematics and Statistics - II

Year: I **SEM:** II	**Course Code:** UCBAD20	**Title of the Course:** Business Mathematics and Statistics – II	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To introduce mathematical applications in business and management, thereby enhancing the logical thinking of the students with regard to problem solving.
2. To train the students to apply statistical techniques in business and management, thereby enhancing the decision making skills of the students.

Course Outcomes (CO)

The learners will be able to

1. Understand mathematical applications in finance.
2. Demonstrate mathematical skills like integration required in economics and business.
3. Comprehend critical thinking and problem solving skills in correlation and regression.
4. Interpret numerical information that forms the basis of index numbers in business.
5. Analyze the theoretical concepts, tools and methods of probability.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	M	L
CO2	H	H	H	H	M	L
CO3	H	H	M	H	M	L
CO4	H	H	L	H	M	H
CO5	H	M	H	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	L	H
CO4	H	H	M	L	M	H
CO5	H	H	H	L	H	H

(Low - L, Medium - M, High - H)

Course Syllabus

Unit I: Mathematics of Finance **(15 hours)**

1.1 Mathematics of finance (K1, K2, K3, K4)
1.2 Simple and Compound interest (K1, K2, K3, K4)
1.3 Discount on bills (K1, K2, K3, K4)
1.4 Pay roll wages (K1, K2, K3, K4)
1.5 Commission (K1, K2, K3, K4)
1.6 Annuities (K1, K2, K3, K4)

Unit II: Integration **(15 hours)**

2.1 Integration, Indefinite integrals, Standard forms (K1, K2, K3, K4)
2.2 Integration of x^n, $1/x$, e^x (K1, K2, K3, K4)
2.3 Basic theorems on integration, Integration (K1, K2, K3, K4)
2.4 Integration by substitution ($ax+b$, e^{ax+b} , $f'(x)/f(x)$)(K1, K2, K3, K4)
2.5 Integration by partial fractions (K1, K2, K3, K4)
2.6 Integration by parts, Uses of Economics. (K1, K2, K3, K4)

Unit III: Correlation and Regression **(15 hours)**

3.1 Correlation (K1, K2, K3, K4)
3.2 Karl Pearson's coefficient of correlation (K1, K2, K3, K4)
3.3 Spearman's rank correlation (K1, K2, K3, K4)
3.4 Regression (K1, K2, K3, K4)
3.5 Simple regression equations (K1, K2, K3, K4)
3.6 Regression coefficients. (K1, K2, K3, K4)

Unit IV: Index Numbers **(15 hours)**

4.1 Various methods of construction of index numbers, Unweighted index numbers. (K1, K2, K3, K4)
4.2 Weighted index numbers, Quantity index numbers, Value index numbers (K1, K2, K3, K4)
4.3 Test of consistency of index numbers, Time reversal test, Factor reversal test (K1, K2, K3, K4)
4.4 Chain base and fixed base index numbers (K1, K2, K3, K4)
4.5 Base shifting, Consumer price index (K1, K2, K3, K4)
4.6 Aggregate method, Family budget method. (K1, K2, K3, K4)

Unit V: Probability **(15 hours)**

5.1 Permutation and Combination (K1, K2, K3, K4)
5.2 Trial, Event, Sample space (K1, K2, K3, K4)
5.3 Mutually exclusive events, Exhaustive events, Independent events (K1, K2, K3, K4)
5.4 Classical definition of probability, Axiomatic definition of probability (K1, K2, K3, K4)
5.5 Addition and multiplication theorems (without proof) (K1, K2, K3, K4)
5.6 Problems (K1, K2, K3, K4)

Text Books:

1. P. A. Navnitham - Business Mathematics and Statistics - Jai Publishers - Trichy 2007.

2. R. S. N. Pillai and Bagavathi - Statistics, 17th Edition, S. Chand and Company, New Delhi, 1984

3. P. R. Vittal - Business Mathematics, 1st Edition - Margham Publications, Chennai, 1995.

Reference Books:

1. Francis, Andy - Business mathematics and statistics. Cengage Learning EMEA, 2004.

2. Agarwal, B. M. - Business Mathematics & Statistics. Ane Books Pvt. Ltd., 2009.

3. Asim Kumar Manna - Business Mathematics & Statistics. McGraw Hill Education (India) Pvt. Ltd., 2018.

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – III
UCBAG20 – Operations Research I

Year: II **SEM:** III	**Course Code:** UCBAG20	**Title of the Course: Operations Research I**	**Course Type:** Theory	**Course Category:** Core	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To introduce the use of quantitative methods and techniques for effective decision making
2. To provide a detailed knowledge about mathematical, transportation and assignment models.
3. To analyse any real life system with limited constraints and depict it in a model form.
4. To examine the aspects of business and marketing with respect to operations research.

Course Outcomes (CO)

The learners will be able to

1. Understand and solve linear programming problems.
2. Identify and develop the operational research models such as graphical and simplex method.
3. Comprehend advanced linear programming problems using Big M method.
4. Construct and solve transportation models and assignment models.
5. Analyze and evaluate assignment models.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**H**	**H**	**H**	**M**	**H**	**L**
CO2	**H**	**M**	**H**	**M**	**L**	**H**
CO3	**H**	**M**	**H**	**H**	**H**	**L**
CO4	**H**	**H**	**H**	**H**	**M**	**L**
CO5	**H**	**H**	**H**	**H**	**M**	**L**

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	M	M	L	L	H
CO4	H	H	M	L	M	H
CO5	H	H	M	L	M	H

(Low-L, Medium - M, High - H)

Course Syllabus

Unit I: Introduction and Mathematical Formulation **(18 hours)**

1.1 Operations research: Definition (K1, K2, K3, K4)
1.2 Scope, Characteristics (K1, K2, K3, K4)
1.3 Models of operations research: Iconic (K1, K2, K3, K4)
1.4 Analogue, Symbolic model (K1, K2, K3, K4)
1.5 Linear programming (K1, K2, K3, K4)
1.6 Formulation. (K1, K2, K3, K4)

Unit II: Linear Programming **(18 hours)**

2.1 Linear Programming: Graphical method (problems: part I) (K1, K2, K3, K4)
2.2 Graphical method (problems: part II) (K1, K2, K3, K4)
2.3 Graphical method (problems: part III) (K1, K2, K3, K4)
2.4 Regular simplex Method (problems: part I) (K1, K2, K3, K4)
2.5 Regular simplex Method (problems: part II) (K1, K2, K3, K4)
2.6 Regular simplex Method (problems: part III) (K1, K2, K3, K4)

Unit III: Linear Programming **(18 hours)**

3.1 Linear programming: Big 'M' method (problems part I) (K1, K2, K3, K4)
3.2 Big 'M' method (problems part II) (K1, K2, K3, K4)
3.3 Big 'M' method (problems part III) (K1, K2, K3, K4)
3.4 Duality (problems part I) (K1, K2, K3, K4)
3.5 Duality (problems part II) (K1, K2, K3, K4)
3.6 Duality (problems part III) (K1, K2, K3, K4)

Unit IV: Transportation Model **(18 hours)**

4.1 Transportation Problem (K1, K2, K3, K4)
4.2 Initial basic feasible solution using North West Corner rule(K1, K2, K3, K4)
4.3 Initial basic feasible solution using least cost method and Vogel's approximation method (K1, K2, K3, K4)
4.4 Degeneracy, Unbalanced Transportation problem (K1, K2, K3, K4)
4.5 Maximization problem(K1, K2, K3, K4)
4.6 Test of Optimality using MODI method (K1, K2, K3, K4)

Unit V: Assignment Model **(18 hours)**

5.1 Assignment problems (K1, K2, K3, K4)
5.2 Minimal assignment problems (K1, K2, K3, K4)
5.3 Unbalanced Assignment problems (K1, K2, K3, K4)
5.4 Restricted Assignment problems (K1, K2, K3, K4)
5.5 Maximization problem in Assignment (K1, K2, K3, K4)
5.6 Maximization problems in Assignment Problems (K1, K2, K3, K4)

Text Books:

1. Premkumar Gupta and Hira D. S. - Introduction to Operations Research, 1st Edition – S.Chand Company Ltd., 1998.

2. Vittal P. R - Introduction to Operations Research, 1st Edition - Margham Publishers – 1999.

Reference Books:

1. Kalavathy. S - Operations Research, 2nd Edition - Vikas Publishing Ltd., 2002.

2. K. Pandian, C. Kayalvizhi - Applied Operations Research for Management, 2nd Edition, Thirumalaa Publications, 2004.

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – IV
UCBAI20 – Operations Research II

Year: II **SEM:** IV	**Course Code:** UCBAI20	**Title of the Course:** Operations Research - II	**Course Type:** Theory	**Course Category:** Core	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To improve problem solving skills of students and make them to use the skills in daily life problems
2. To improve knowledge in Sequencing Problems, Queuing theory and Network Analysis.

Course Outcomes (CO)

The learners will be able to

1. Utilize the concepts of Operation research in real life experiments and plan the Sequencing of jobs through machines.
2. Evaluate the critical path and project duration in CPM.
3. Compute the Probability of meeting the scheduled dates in PERT and compare CPM and PERT.
4. Acquire the solutions for Game of two players in Game theory.
5. Analyze the queuing theory for single channel problems.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**H**	**H**	**H**	**M**	**H**	**L**
CO2	**H**	**M**	**H**	**M**	**L**	**H**
CO3	**H**	**M**	**H**	**H**	**H**	**L**
CO4	**H**	**H**	**H**	**H**	**M**	**L**
CO5	**H**	**H**	**H**	**H**	**M**	**L**

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	L	H
CO4	H	H	M	L	M	H
CO5	H	H	H	L	M	H

(Low-L, Medium - M, High - H)

Course Syllabus

Unit I: Sequencing Problems **(18 hours)**

1.1 Introduction – Definition of Sequencing (K1, K2)
1.2 Basic steps – Job assigning through machines (K1, K2)
1.3 Processing n jobs through two machines (K1, K2, K3, K4)
1.4 Processing n jobs through three machines (K1, K2, K3, K4)
1.5 Processing two jobs through m machines (K1, K2, K3, K4)
1.6 Processing n jobs through m machines (K1, K2, K3, K4)

Unit II: Network Analysis: CPM Computations **(18 hours)**

2.1 Introduction – Network diagram representation (K1, K2)
2.2 Rules for constructing the network (K1, K2)
2.3 Numbering the events – Different time Calculation (K1, K2, K3, K4)
2.4 CPM representation in Tabular form (K1, K2, K3, K4)
2.5 Total, Independent and free float Calculations (K1, K2, K3, K4)
2.6 Calculation of CPM and Project duration (K1, K2, K3, K4)

Unit III: Network Analysis: PERT Computations **(18 hours)**

3.1 Network diagram representation (K1, K2)
3.2 Basic Steps in PERT (K1, K2)
3.3 Difference between PERT and CPM (K1, K2, K3, K4)
3.4 Calculation of Critical path and Project duration (K1, K2, K3, K4)
3.5 Probability of meeting the scheduled dates (K1, K2, K3, K4)
3.6 Calculation of project duration for the scheduled dates (K1, K2, K3, K4)

Unit IV: Game Theory **(18 hours)**

4.1 Introduction characteristic of Games- Definition (K1, K2)
4.2 Meaning for Saddle points (K1, K2)
4.3 Game without Saddle points (K1, K2, K3, K4)
4.4 Games without Saddle points – Mixed Strategy
4.5 Basic Steps -Dominance property (K1, K2)
4.6 Games problems using Dominance property (K1, K2, K3, K4)

Unit V: Queuing Theory **(18 hours)**

5.1 Introduction - Meaning – Queuing theory (K1, K2)
5.2 Various types of Queuing Model (K1, K2)
5.3 Single channel Queuing theory (infinite capacity only) (K1, K2, K3, K4)
5.4 Different formulae (without derivation) - Concepts
5.5 Calculation of Single Channel systems (K1, K2, K3, K4)
5.6 Problems solving using Queuing theory (K1, K2, K3, K4)

Text Books:

1. Kalavathy. S - Operations Research, 2nd Edition - Vikas Publishing Ltd., 2002.

2. Vittal P.R. - Introduction to Operations Research, 1st Edition - Margham Publishers – 1999.

Reference Books:

1. Premkumar Gupta and Hira D.S. - Introduction to Operations Research, 1st Edition – S.Chand Company Ltd., 1998.

2. K. Pandian, C.Kayalvizhi - Applied Operations Research for Management, 2nd Edition, Thirumalaa Publications, 2004

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – I
UABMA20 – Business Mathematics and Statistics

Year: I **SEM:** I	**Course Code:** UABMA20	**Title of the Course:** Business Mathematics and Statistics	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To provide an opportunity to master mathematical applications in Economics, Finance, Commerce and Management.
2. To develop the ability of students to deal with numerical and quantitative issues in business.
3. To have a strong understanding of statistical applications in Economics and Management.
4. To enable the use of statistical techniques wherever relevant.

Course Outcomes (CO)

The learners will be able to

1. Apply the knowledge in matrices in solving business problems.
2. Analyze and demonstrate differentiation skills in economics and business.
3. Apply statistical and graphical techniques wherever relevant.
4. Apply the concepts, tools and techniques in business statistical analysis.
5. Solve a range of problems using the techniques covered.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	L	H
CO4	H	H	M	L	M	H
CO5	H	H	M	L	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Matrices **(15 hours)**

1.1 Definition, Types of matrices (K1, K2, K3, K4)
1.2 Matrix operations, Determinant of a matrix (K1, K2, K3, K4)
1.3Singular and non-singular matrices (K1, K2, K3, K4)
1.4 Inverse of a matrix by co-factor method (K1, K2, K3, K4)
1.5 Rank of a matrix (K1, K2, K3, K4)
1.6 Solution of system of linear simultaneous equations using Cramer's rule (K1, K2, K3, K4)

Unit II: Differentiation **(15 hours)**

2.1 Differentiation (K1, K2, K3, K4)
2.2 Derivatives of standard functions x^n, e^x, log x, constant (without proof) (K1, K2, K3, K4)
2.3 Rules of differentiation (Addition, difference, product, quotient) (K1, K2, K3, K4)
2.4 Chain rule, Successive differentiation (up to second derivative) (K1, K2, K3, K4)
2.5 Uses: Marginal Concepts, Elasticity of demand, Increasing and decreasing functions (K1, K2, K3, K4)
2.6 Maxima and minima, break - even point. (K1, K2, K3, K4)

Unit III: Classification and Graphical Representation **(15 hours)**

3.1 Introduction, meaning of classification, chief characteristics of classification, objects of classification rules of classification (K1, K2, K3, K4)
3.2 Frequency distribution, individual observations (K1, K2, K3, K4)
3.3 Discrete frequency distributions continuous frequency distribution (K1, K2, K3, K4)
3.4 Frequency distribution, graph of frequency distribution (K1, K2, K3, K4)
3.5 Histogram (K1, K2, K3, K4)
3.6 Frequency polygon, frequency curve. (K1, K2, K3, K4)

Unit IV: Measures of Central Tendency **(15 hours)**

4.1 Arithmetic mean (K1, K2, K3, K4)
4.2 Median (K1, K2, K3, K4)
4.3 Mode (K1, K2, K3, K4)
4.4 Empirical formulae, Combined and Weighted arithmetic mean (K1, K2, K3, K4)
4.5 Geometric mean (K1, K2, K3, K4)
4.6 Harmonic mean. (K1, K2, K3, K4)

Unit V: Measures of Dispersion and Skewness **(15 hours)**

5.1 Range (K1, K2, K3, K4)
5.2 Quartile deviation (K1, K2, K3, K4)
5.3 Mean deviation (K1, K2, K3, K4)
5.4 Standard deviation (K1, K2, K3, K4)
5.5 Karl Pearson’s coefficient of skewness (K1, K2, K3, K4)
5.6 Bowley’s coefficient of skewness. (K1, K2, K3, K4)

Text Books:

1. P. A. Navnitham - Business Mathematics and Statistics - Jai Publishers - Trichy 2007.

2. R. S. N. Pillai and Bagavathi - Statistics, 17th Edition, S. Chand and Company - New Delhi, 1984.

Reference Books:

1. Francis, Andy - Business Mathematics and Statistics. Cengage Learning EMEA, 2004.

2. Agarwal, B. M. - Business Mathematics & Statistics. Ane Books Pvt Ltd, 2009.

3. Asim Kumar Manna - Business Mathematics & Statistics. McGraw Hill Education (India) Pvt. Ltd., 2018.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – II

UASOR20 – Business Statistics and Operations Research

Year: I **SEM:** II	**Course Code:** UASOR20	**Title of the Course:** Business Statistics and Operations Research	**Course Type:** Theory	**Course Category:** Allied	**H/W** 5	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To deepen the knowledge of statistical concepts and to introduce the concepts of Operations Research.
2. To demonstrate and apply the concepts of probability and game theory.

Course Outcomes (CO)

The learners will be able to

1. Gain practical knowledge of correlation and regression.
2. Understand the basic concepts of index numbers.
3. Learn the ideas of possible outcomes.
4. Develop mathematical skills to optimize transportation and assignment problem.
5. Propose the best strategy using decision making methods under uncertainty and game theory.

CO	**PSO**					
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	L	H
CO4	H	H	M	L	M	H
CO5	H	H	M	L	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Correlation and Regression **(15 hours)**

1.1 Introduction (K1,K2)
1.2 Scatter Diagram (K1,K2,K3)
1.3 Karl Pearson's coefficient of correlation (K1, K2, K3, K4)
1.4 Spearman's Rank correlation(K1, K2, K3)
1.5 Methods of forming the regression equations (K1, K2, K3)
1.6 Properties of regression lines and coefficients. (K1, K2, K3, K4)

Unit II: Index Numbers **(15 hours)**

2.1 Various methods of construction of index numbers (K1, K2)
2.2 Methods, Simple Aggregate, Weighted Aggregate (K1, K2, K3, K4)
2.3 Quantity Index numbers, Value Index numbers (K1, K2, K3, K4)
2.4 Test of consistency of index numbers, Time reversal test, Factor reversal test (K1, K2, K3, K4)
2.5 Base shifting (K1, K2, K3)
2.6 Consumer price index, Family budget method.(K1,K2,K3)

Unit III: Probability **(15 hours)**

3.1 Permutation, Combination (K1, K2)
3.2 Definitions of Trial, Event, Sample space, Mutually Exclusive Cases, Exhaustive events, Independent events (K1, K2, K3)
3.3 Classical definition of probability (K1, K2)
3.4 Axiomatic Definition of probability (K1, K2)
3.5 Addition and multiplication theorem (without proof) (K1, K2)
3.6 Problems (K1, K2, K3, K4)

Unit IV: Transportation and Assignment model **(15 hours)**

4.1 Transportation model: Initial basic feasible solution (K1, K2, K3, K4)
4.2 Test for Optimality (K1, K2, K3, K4)
4.3 MODI method (omit degeneracy) (K1, K2, K3, K4)
4.4 Assignment Model: Assignment problem (K1, K2, K3, K4)
4.5 Minimal assignment problem (K1, K2, K3, K4)
4.6 Hungarian method. (K1, K2, K3, K4)

Unit V: Game Theory **(15 hours)**

5.1 Introduction (K1)
5.2 Meaning (K1, K2)
5.3 The Maximin and Minimax principles (K1, K2, K3, K4)
5.4 Saddle point (K1, K2, K3, K4)
5.5 Games without saddle points (Mixed strategies) (K1, K2, K3, K4)
5.6 Dominance property (Excluding graphical and LPP methods) (K1, K2, K3, K4)

Text Books:

1. P. A. Navnitham - Business Statistics and Operations Research - Jai Publishers, Trichy 2007.
2. R. S. N. Pillai and Bhagavathi-Statistics, S.Chand and Company, New Delhi, 17th Edition 1984.
3. Kalavathy. S - Operations Research, 2 nd Edition - Vikas Publishing Ltd., 4th edition 2013.

Reference Books:

1. Dr. P.R. Vittal - Mathematical Statistics, Margam Publications, 2015.
2. P.K. Gupta and D.S. Hira – Problems in Operations Research, 1 st Edition – Chand and Company Ltd., 1995.
3. Dr. S. P. Gupta and Dr. M.P. Gupta – Business Statistics – Sultan Chand & Sons, New Delhi, 16th edition, 2010.

E-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – I
UAMAA20 / UBMAA20 – Allied Mathematics I

Year: I **SEM:** I	**Course Code :** UAMAA20/ UBMAA20	**Title Of The Course :** Allied Mathematics I	**Course Type :** Theory	**Course Category :** Allied	**H/W** 6	**CREDITS** 5	**MARKS** 100

Course Objectives

1. To introduce the basic concepts of matrices
2. To improve problem solving skills in Trigonometry
3. To introduce various methods to solve equations
4. To introduce differential and integral calculus

Course Outcomes (CO)

The learners will be able to

1. Understand the basic concepts of matrices
2. Apply the theory of equations and find roots using Newton's and Horner's method.
3. Acquire problem solving skills in trigonometry.
4. Compute radius of curvature, centre of curvature, evolutes and involutes.
5. Apply the techniques of integral calculus.

CO	**PSO**					
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	H	H	H	H	H	L
CO2	H	H	H	H	M	L
CO3	H	H	H	H	L	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	L	L

CO	**PO**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO1	H	H	H	H	H	L
CO2	H	H	H	H	M	L
CO3	H	H	H	H	L	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	L	L

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: **Matrices** **(18 hours)**

1.1 Symmetric, Skew symmetric, Hermitian, Skew Hermitian (K1, K2, K3, K4)
1.2 Orthogonal, Unitary matrices (K1, K2, K3, K4)
1.3 Eigen values and Eigen vectors (K1, K2, K3, K4)
1.4 Cayley-Hamilton Theorem (without proof) (K1, K2, K3, K4)
1.5 Verification and computation of inverse (K1, K2, K3, K4)
1.6 Diagonalisation of a matrix (K1, K2, K3, K4)

Unit II: Theory of Equations **(18 hours)**

2.1 Polynomial equations (K1, K2, K3, K4)
2.2 Irrational roots – Complex roots (K1, K2, K3, K4)
2.3 Reciprocal equations (K1, K2, K3, K4)
2.4 Descarte's Rule of signs (K1, K2, K3, K4)
2.5 Approximation of roots of polynomial equation by Newton's method (K1, K2, K3, K4)
2.6 Horner's methods (K1, K2, K3, K4)

Unit III: Trigonometry **(18 hours)**

3.1Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ (K1, K2, K3, K4)
3.2 Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ (continued) (K1, K2, K3, K4)
3.3 Expansion of $\sin^n \theta$, $\cos^n \theta$ (K1, K2, K3, K4)
3.4 Expansions of $\sin\theta$, $\cos\theta$, $\tan\theta$ in terms of θ (K1, K2, K3, K4)
3.5 Expansions of $\sin\theta$, $\cos\theta$, $\tan\theta$ in terms of θ (continued) (K1, K2, K3, K4)
3.6 Logarithm of a complex number (K1, K2, K3, K4)

Unit IV: Differential Calculus **(18 hours)**

4.1 Curvature (K1, K2, K3, K4)
4.2 Radius of curvature in Cartesian Coordinates (K1, K2, K3, K4)
4.3 Polar Coordinates, (K1, K2, K3, K4)
4.4 p-r equations (K1, K2, K3, K4)
4.5 Evolutes (K1, K2, K3, K4)
4.6 Involutes (K1, K2, K3, K4)

Unit V: Integral Calculus **(18 hours)**

5.1 Integration by parts (K1, K2, K3, K4)
5.2 Bernoulli's formula (K1, K2, K3, K4)
5.3 Reduction formulae $\sin^n x$ (K1, K2, K3, K4)
5.4 Reduction formulae $\cos^n x$ (K1, K2, K3, K4)
5.5 Reduction formulae $\tan^n x$, $\operatorname{cosec}^n x$ (K1, K2, K3, K4)
5.6 Reduction formulae $\sec^n x$, $\cot^n x$ (K1, K2, K3, K4)

Text Books:

1. S. Narayanan and others – Ancillary Mathematics – Volumes I, II, III and IV-S.Viswanathan Printers and Publishers Private Limited, 2007

Reference Books:

1. T.K.Manikavachogam Pillay and others – Algebra – Volume II – S. Viswanathan Printers and Publishers Private Limited, 2006

2. T.K.Manikavachogam Pillay and others – Differential Calculus - S.Viswanathan Printers and Publishers Private Limited – Volume I, 2007

3. T.K.Manikavachagom Pillay and others – Integral Calculus - S.Viswanathan Printers and Publishers Private Limited - Volume II, 2007

4. P.R. Vittal - Allied Mathematics – Margham Publications - Third Edition, 2002

e-Resource:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – II
UAMAB20 – Allied Mathematics II

Year : I **SEM :**II	**Course Code :** UAMAB20	**Title Of The Course :** Allied Mathematics: II	**Course Type :** Theory	**Course Category :** Allied	**H/W 6**	**CREDITS 5**	**MARKS 100**

Course Objectives

1. To introduce concepts of vector calculus
2. To teach methods of solving partial differential equations
3. To introduce Laplace transforms and Fourier Series

Course Outcomes (CO)

The learners will be able to

1. Understand the use of vector calculus in science and engineering.
2. Understand the applications of Green's, Gauss divergence and Stoke's Theorems.
3. Find the complete, singular and general integral of partial differential equations.
4. Understand the basic concepts of Laplace Transforms.
5. Determine the nature of the Fourier series and find its coefficients

CO	**PSO**					
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	H	H	H	H	H	L
CO2	H	H	H	H	H	L
CO3	H	H	H	H	M	L
CO4	H	H	H	H	M	L
CO5	H	H	H	H	H	L

CO	**PO**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO1	H	H	H	H	H	L
CO2	H	H	H	H	M	L
CO3	H	H	H	H	L	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	L	L

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Differentiation of vectors (18 hours)

1.1 Scalar and vector point functions (K1, K2, K3, K4)
1.2 Differentiation of vectors (K1, K2, K3, K4)
1.3 Differential operators (K1, K2, K3, K4)
1.4 Directional derivatives (K1, K2, K3, K4)
1.5 Gradient (K1, K2, K3, K4)
1.6 Divergence and Curl (K1, K2, K3, K4)

Unit II: Integration of vectors (18 hours)

2.1 Line Integral (K1, K2, K3, K4)
2.2 Surface Integral (K1, K2, K3, K4)
2.3 Volume Integral (K1, K2, K3, K4)
2.4 Green's theorem statement and application (K1, K2, K3, K4)
2.5 Gauss's theorem statement and application (K1, K2, K3, K4)
2.6 Stoke's theorem statement and application (K1, K2, K3, K4)

Unit III: Partial Differential Equations (18 hours)

3.1 Formation of Partial Differential equations by eliminating arbitrary constants (K1, K2, K3, K4)
3.2 Formation of Partial Differential equations by eliminating arbitrary functions (K1, K2, K3, K4)
3.3 Solutions of standard types of first order differential equations – $f(p,q) = 0$ (K1, K2, K3, K4)
3.4 Solution of $f(x,p,q) = 0$; $f(y,p,q) = 0$; $f(z,p,q) = 0$ (K1, K2, K3, K4)
3.5 Solution of $f1(x,p) = f_2(y,q)$ (K1, K2, K3, K4)
3.6 Solution of $z = px+qy+f(p,q)$ (K1, K2, K3, K4)

Unit IV: Laplace Transformations (18 hours)

4.1 Definition of Laplace transforms (K1, K2, K3, K4)
4.2 Laplace transforms of standard functions (K1, K2, K3, K4)
4.3 Laplace transforms – problems (K1, K2, K3, K4)
4.4 Laplace transforms – problems (continued) (K1, K2, K3, K4)
4.5 Inverse Laplace Transforms (K1, K2, K3, K4)
4.6 Solving ordinary differential equations of second order with constant coefficients using Laplace transforms (K1, K2, K3, K4)

Unit V: Fourier Series (18 hours)

5.1 Definition of Fourier series (K1, K2, K3, K4)
5.2 Fourier series –Problems (K1, K2, K3, K4)
5.3 Finding Fourier coefficients for a given periodic function with period 2π (K1, K2, K3, K4)
5.4 Odd functions (K1, K2, K3, K4)
5.5 Even function (K1, K2, K3, K4)
5.6 Half range series.(K1, K2, K3, K4)

Text Books:

1. S.Narayanan and others – Ancillary Mathematics – Volumes I, II, III and IV, S.Viswanathan Printers and Publishers Private Limited, 2007.

Reference Books:

1. P.R. Vittal - Allied Mathematics – Margham Publications - Third Edition, 2002

2. T.K.Manikavachagom Pillay and others – Ancillary Mathematics Volume I and Volume II - S.Viswanathan Printers and Publishers Private Limited, 2004

3. P.Kandasamy and K.Thilagavathi - Allied Mathematics Volume I and Vloume II - S.Chand and Co, New Delhi, 2004.

e-Resourse:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – III
UANAA20 – Numerical Analysis I

Year: II **SEM:**III	**Course Code:** UANAA20	**Title of the Course:** Numerical Analysis I	**Course Type:** Theory	**Course Category:** Allied	**H/W** 6	**CREDITS** 5	**MARKS** 100

Course Objectives

1. To introduce the concepts of Numerical Analysis.
2. To provide suitable and effective methods called numerical methods, for obtaining approximate representative numerical results of problems.

Course Outcomes (CO)

The learners will be able to

1. Understand the operators and their properties, form a forward and backward difference table.
2. Execute interpolation methods using forward and backward differences when the data is equally distributed.
3. Exhibit interpolation procedures using central differences when the data is equally distributed.
4. Use divided differences for interpolation when the data is unequally distributed.
5. Implement curve fitting and method of moments.

CO	**PSO**					
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	M	H
CO4	H	H	M	L	M	H
CO5	H	H	M	L	M	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Finite Differences **(18 hours)**

1.1 Forward Differences table and Backward differences table (K1,K2)
1.2 Differences of polynomial and factorial polynomial (K1,K2,K3)
1.3 Reciprocal factorial and Polynomial in Factorial Notation (K1,K2,K3)
1.4 Error propagation in difference table (K1, K2, K3, K4)
1.5 Other differences operators (K1,K2,K3,K4)
1.6 Summation of series (K1,K2,K3,K4)

Unit II: Interpolation **(18 hours)**

2.1 Introduction (K1, K2)
2.2 Newton's Forward interpolation formula (K1, K2, K3, K4)
2.3 Newton's backward interpolation formula (K1, K2, K3, K4)
2.4 Error in polynomial interpolation (K1, K2, K3, K4)
2.5 Equidistant terms with one or more missing terms (K1, K2, K3, K4)
2.6 Introduction and Form a central difference table (K1, K2)

Unit III: Central Difference Table **(18 hours)**

3.1 Gauss Forward Interpolation formula (K1, K2, K3, K4)
3.2 Gauss backward Interpolation formula (K1, K2, K3, K4)
3.3 Stirling's Formula (K1, K2, K3, K4)
3.4 Bessel's Formula (K1, K2, K3, K4)
3.5 Laplace – Everett's formula (K1, K2, K3, K4)
3.6 Relation between Bessel's and Laplace – Everett's formula (K1, K2, K3, K4)

Unit IV: Interpolation with Unequal intervals **(18 hours)**

4.1 Properties of divided difference (K1, K2, K3)
4.2 Relation between divided differences and forward differences (K1, K2, K3)
4.3 Newton's divided difference formula (K1, K2, K3, K4)
4.4 Lagrange's interpolation formula and its problem (K1, K2, K3, K4)
4.5 Inverse interpolation and Lagrange's method (K1, K2, K3, K4)
4.6 Iterative method (K1, K2, K3, K4)

Unit 5: Empirical Laws and Curve Fitting **(18 hours)**

5.1 The Linear law and Laws Reducible to linear law (K1, K2, K3)
5.2 Method of Group of Averages and Equations involving three constants (K1, K2, K3, K4)
5.3 Principles of least squares and Fitting a Straight line and Parabola (K1, K2, K3, K4)
5.4. Fitting the Exponential Curve and Curve $y = a^x$ (K1, K2, K3, K4)

5.5 Sum of squares of Residuals (K1, K2, K3, K4)
5.6 Method of moments (K1, K2, K3, K4)

Text Book:

1. Dr. V.N.Vedamurthy, Dr. N.Ch.S.N. Iyengar – Numerical Methods, Vikas Publishing House Pvt. Ltd., New Delhi, 1998, Reprint 2011.

Reference Books:

1. S. Kalavathy- Numerical Methods – Thomson Learning – 5, Sheton way, Singapore, 2004.
2. Dr. A. Singravelu – Numerical Methods – Meenakshi Agency – 120, Pushpa Nagar, Medavakkam, Chennai, Revised Edition, Dec 2007.
3. S. Arumugam, A. Thangapandi Isaac, A.Somasundaram – Numerical Methods, 2nd edition – SciTech Publishing Pvt. Ltd., Chennai – Reprint Sep 2005.
4. R. Gupta – Numerical Analysis, Revised Edition – Laxmi Publishing Ltd., New Delhi, 2001.
5. S. G. Venkatachalapathy – Calculus of Finite Differences and Numerical Analysis, 1st Edition, Margham Publications, 2003.

e - Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – IV
UANAB20 – Numerical Analysis II

Year: II **SEM:** IV	**Course Code:** UANAB20	**Title of the Course:** Numerical Analysis-II	**Course Type:** Theory	**Course Category:** Allied	**H/W** 6	**CREDITS** 5	**MARKS** 100

Course Objectives

1. To familiarize the students with finding root of equations, solving systems of linear algebraic equation, numerical integration and differentiation.
2. To solve differential equation with boundary value problems.

Course Outcomes (CO)

The learners will be able to

1. Obtain numerical solutions of algebraic and transcendental equations.
2. Find numerical solutions of system of linear equations.
3. Use numerical methods to do differentiation.
4. Use numerical methods to do integration.
5. Solve ordinary differential equations using numerical methods.

CO	**PSO**					
	PSO1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	H	H	M	L	M	H
CO2	H	H	M	L	M	H
CO3	H	H	M	L	M	H
CO4	H	H	M	L	M	H
CO5	H	H	M	L	M	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Solutions of Algebraic and Transcendental Equations (18 hours)

1.1 Bisection Method (K1, K2, K3, K4)
1.2 Iteration Method (K1, K2, K3, K4)
1.3 Newton Raphson Method (K1, K2, K3, K4)
1.4 Regular Falsi Method (K1, K2, K3, K4)
1.5 Horner's method (K1, K2, K3, K4)
1.6 Graffe's root squaring method (K1, K2, K3, K4)

Unit II: Solutions of Simultaneous Linear Algebraic Equations (18 hours)

2.1Gauss Elimination Method (K1, K2, K3, K4)
2.2 Gauss – Jordan Method (K1, K2, K3, K4)
2.3 Jacobi's Method (K1, K2, K3, K4)
2.4 Gauss- Seidel Method (K1, K2, K3, K4)
2.5 Crout's method (K1, K2, K3, K4)
2.6 Inverse Crout's method (K1, K2, K3, K4)

Unit III: Numerical Differentiation and Numerical Integration (18 hours)

3.1 Newton's forward difference formula (K1, K2, K3, K4)
3.2 Newton's backward difference formula (K1, K2, K3, K4)
3.3 Derivatives using Stirling's formula (K1, K2, K3, K4)
3.4 Maxima and Minima (K1, K2, K3, K4)
3.5Trapezoidal Rule, Simpson's One-Third Rule, Simpson's Three-Eight Rule (K1, K2, K3, K4)
3.6 Weddle's Rule and Romberg Method (K1, K2, K3, K4)

Unit IV: Numerical Solution of Ordinary Differential Equations (18 hours)

4.1 Taylor's series Method for simultaneous first order and higher order differential equations (K1, K2, K3, K4)
4.2 Picard's method of successive approximations (K1, K2, K3, K4)
4.3 Picard's method for first order differential equations (K1, K2, K3, K4)
4.4 Picard's method for second order differential equations (K1, K2, K3, K4)
4.5 Euler's method and Improved Euler's method (K1, K2, K3, K4)
4.6 Modified Euler's method (K1, K2, K3, K4)

Unit V Numerical Solution of Ordinary Differential Equations (Continued) (18 hours)

5.1 Runge – Kutta method and Higher order R-K methods (K1, K2, K3, K4)
5.2 Runge – Kutta methods for simultaneous first order Equations (K1, K2, K3, K4)
5.3 Runge – Kutta methods for simultaneous second order Equations (K1, K2, K3, K4)
5.4 Predictor – Corrector Method (K1, K2, K3, K4)
5.5 Milne's Method (K1, K2, K3, K4)
5.6 Adams – Bashforth Method (K1, K2, K3, K4)

Text Book:

1. Dr. V.N.Vedamurthy, Dr.N.Ch.S.N. Iyengar – Numerical Methods, Vikas Publishing House Pvt. Ltd., New Delhi, 1998, Reprint 2011.

Reference Books:

1. S.Kalavathy- Numerical Methods – Thomson Learning – 5, Sheton way, Singapore, 2004.
2. Dr.A.Singravelu – Numerical Methods – Meenakshi Agency – 120, Pushpa Nagar, Medavakkam, Chennai, Revised Edition, Dec 2007.
3. S. Arumugam, A. Thangapandi Isaac, A.Somasundaram – Numerical Methods, 2nd edition, SciTech Publishing Pvt. Ltd., Chennai – Reprint Sep 2005.
4. R. Gupta – Numerical Analysis, Revised Edition – Laxmi Publishing Ltd., New Delhi, 2001.
5. S. G.Venkatachalapathy – Calculus of Finite Differences and Numerical Analysis, 1st Edition, Margham Publications, 2003.

e- Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – III
UACAA20 – Mathematical Foundations

Year : II **SEM :**III	**Course Code :** UACAA20	**Title Of The Course :** Mathematical Foundations	**Course Type :** Theory	**Course Category :** Core	**H/W** 6	**CREDITS** 6	**MARKS** 100

Course Objectives

1. To provide basic mathematical concepts required for computer applications.
2. To introduce the notion of relations and functions
3. To learn simple methods in algebra

Course Outcomes (CO)

The learners will be able to

1. Understand the concepts of Mathematical logic and compute the operators on Symbolic logic.
2. Acquire knowledge about relations and functions.
3. Assess real life simple problems with permutation, combination and probability.
4. Know about matrices and their types.
5. Differentiate standard trigonometric functions.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	H
CO2	H	H	H	M	L	H
CO3	M	L	H	H	H	H
CO4	M	L	H	H	H	H
CO5	H	H	M	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	M
CO2	H	H	H	M	L	M
CO3	H	H	M	M	L	H
CO4	H	H	H	M	L	M
CO5	H	H	H	M	L	M

(Low-L, Medium - M, High - H)

Course Syllabus

Unit I: Symbolic logic **(18 hours)**

1.1 Symbolic logic (K1, K2, K3)
1.2 Logical operator (K1, K2, K3)
1.3 Conditional and bi-conditional operators (K1, K2, K3)
1.4 Converse, Inverse, Contra positive (K1, K2, K3)
1.5 Tautology and Contradiction (K1, K2, K3, K4)
1.6 Algebra of Propositions (K1, K2, K3, K4)

Unit II: Relations and Functions **(18 hours)**

2.1Relation (K1, K2, K3)
2.2 Equivalence relation (K1, K2, K3)
2.3 Partition, Partial order relation (K1, K2, K3, K4)
2.4 Functions, Inverse (K1, K2, K3, K4)
2.5 Composition of functions (K1, K2, K3)
2.6 Properties of functions (K1, K2, K3, K4)

Unit III: Algebra **(18 hours)**

3.1 Probability (K1, K2, K3)
3.2 Probability (simple problems) (K1, K2, K3, K4)
3.3 Permutations (K1, K2, K3, K4)
3.4 combinations (K1, K2, K3, K4)
3.5 Combinatorial arguments (K1, K2, K3, K4)
3.6 Boolean algebra (K1, K2, K3)

Unit IV: **Matrices** **(18 hours)**

4.1Types of matrices (K1, K2, K3)
4.2 Matrix operations, Symmetric and skew symmetric, Hermitian and skew-Hermitian (K1, K2, K3)
4.3 Orthogonal and Unitary (K1, K2, K3, K4)
4.4 Rank of a matrix (K1, K2, K3, K4)
4.5 Solution of system of linear equations using matrices (K1, K2, K3, K4)
4.6 Cramer's rule (K1, K2, K3)

Unit V: Differential calculus **(18 hours)**

5.1 Differentiation of standard function x^n (K1, K2, K3)
5.2 Differentiation of standard function e^x (K1, K2, K3)
5.3 Differentiation of standard function logx (K1, K2, K3)
5.4 Differentiation of standard functions sinx, cosx, tanx (K1, K2, K3)
5.5 Chain Rule (K1, K2, K3)

5.6 Successive differentiation (up to second derivative) (K1, K2, K3)

Text Books:

1. P.R.Vittal-Mathematical Foundations-Margham Publications, Chennai, 2nd Edition – 2003.

2. PA.Navanitham-Business Statistics-jai publishers, Trichy-21.

Reference Books:

1. P.R. Vittal - Allied Mathematics – Margham Publications - Third Edition, 2002

2. M.K.Venkataraman - Engineering Mathematics, Volumes I and II - The National Publication Co., Madras, 1992 and 1993

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – IV
UACAB20 – Statistical Methods

Year: II **SEM:** IV	**Course Code:** UACAB20	**Title of the Course:** Statistical Methods	**Course Type:** Theory	**Course Category:** Core	**H/W** 6	**CREDITS** 4	**MARKS** 100

Course Objectives

1. To enrich the knowledge of students on statistical methods which play a major role in computer applications
2. To demonstrate sampling techniques and to employ statistical methods of analysis to make inference

Course Outcomes (CO)

The learners will be able to

1. Analyse the statistical data using measures of central tendency and graphs.
2. Provide an overall description of a set of data using measures of dispersion.
3. Apply the concept of regression and correlation in business problems.
4. Make decisions using hypothesis testing.
5. Apply the Chi-square test for independence as well as goodness of fit.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	M	H	H
CO2	H	H	M	L	H	H
CO3	M	L	H	H	H	H
CO4	M	H	H	H	H	L
CO5	H	H	H	M	L	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	H
CO2	H	H	M	L	M	H
CO3	H	H	H	H	L	M
CO4	H	H	M	L	L	H
CO5	H	H	H	M	L	H

(Low- L, Medium - M, High - H)

Course Syllabus

Unit 1: Introduction of Statistics and Measurements of Central Tendency (18 hours)

1.1 Definition of Statistics, Classification and Tabulation (K1, K2)
1.2 Graphical representation of numerical data (K1, K2, K3)
1.3 Formation of frequency distribution (K1, K2, K3)
1.4 Mean and its types (K1, K2, K3, K4)
1.5 Median and its types(K1, K2, K3, K4)
1.6 Mode and its types (K1, K2, K3, K4)

Unit II: Measures of Dispersion (18 hours)

2.1 Basic definition of Measures of Dispersion (K1, K2)
2.2 Sums on range (K1, K2)
2.3 Sums on quartile deviation (K1, K2, K3)
2.4 Sums on Mean deviation about mean and median (K1, K2, K3, K4)
2.5 Sums on Standard deviation (K1, K2, K3, K4)
2.6 Sums on coefficient of Variation **(**K1, K2, K3, K4)

Unit III: Correlation and Regression (18 hours)

3.1 Definitions of Correlation and its types (K1, K2)
3.2 Karl Pearson's Co-efficient of correlation (K1, K2, K3, K4)
3.3 Bivariate Correlation (K1, K2, K3, K4)
3.4 Spearman Rank Correlation (K1, K2, K3, K4)
3.5 Regression equations (K1, K2, K3, K4)
3.6 Regression Co-efficient (K1, K2, K3, K4)

Unit IV: Tests of Hypothesis (18 hours)

4.1 Basic definition of hypothesis (K1, K2)
4.2 Test for single and difference between means (K1, K2, K3, K4)
4.3 Test for single standard deviation and difference standard deviation (K1, K2, K3, K4)
4.4 Test for small correlation coefficient (K1, K2, K3, K4)
4.5 Small samples-Test for single and difference between means (K1, K2, K3, K4)
4.6 Paired t-test (K1, K2, K3, K4)

Unit V: Chi-Square Test and Goodness of Fit (18 hours)

5.1 Definitions of Chi-Square test (K1, K2)
5.2 Properties (K1, K2)
5.3 Sums on Chi-Square test (K1, K2, K3, K4)
5.4 Goodness of Fit (K1, K2, K3, K4)
5.5 Contingency table (K1, K2, K3, K4)
5.6 Test for Independence of Attributes (K1, K2)

Text Book:

1. P. R. Vittal and V. Malini - Statistical and Numerical Methods, 1st Edition - Margham Publications, 2002.

Reference Books:

1. P. R. Vittal-Mathematical Statistics, 1st Edition-Margham Publications, 2002.

2. S. C. Gupta and V. K. Kappor - Fundamentals of Mathematical Statistics, 3rd Edition, Sultan Chand and Sons, 2004.

3. P. Kandasamy and K. Thilagavathy - Calculus of Finite Differences and Numerical Analysis, 1st Edition - Margam Publications, 2003.

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – III
UABSA20 – Biostatistics I

Year: II **SEM:** III	**Course Code:**	**Title of the Course:**	**Course Type:**	**Course Category:**	**H/W**	**CREDITS**	**MARKS**
	UABSA20	Biostatistics – I	Theory	Allied	6	5	100

Course Objectives

1. To deepen the knowledge in various statistical concepts which play an important role in the field of biological sciences.
2. Recognize the importance data collection and its role in determining scope of inference.
3. To apply appropriate statistical methods for analyzing one or two variables.

Course Outcomes (CO)

The learners will be able to

1. Frame a relevant frequency distribution for a given biological data.
2. Determine mean, median, mode for biological data.
3. Compute measures of dispersion.
4. Understand probability concepts.
5. Gain knowledge of correlation and regression and its applications.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	H	H	H	H	L
CO3	H	H	H	H	M	L
CO4	H	H	H	H	M	L
CO5	H	H	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	L	L	H
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

(Low-L, Medium - M, High - H)

Course Syllabus

Unit I: Frequency Distributions (18 hours)

1.1 Introduction (K1)
1.2 Frequency distribution (K1, K2,K3)
1.3 Univariate frequency distribution (K1, K2, K3, K4)
1.4 Bivariate frequency distribution (K1, K2, K3, K4)
1.5 Diagrams –Histogram – Frequency polygon – Frequency curve (K1, K2, K3, K4)
1.6 Characteristics of a frequency distribution (K1, K2, K3, K4)
(Chapter – 5: Section 5.1-5.4)

Unit II: Measures of Central Tendency and Location (18 hours)

2.1 Introduction (K1)
2.2 Mean, Median (K1, K2, K3, K4)
2.3 Quartiles, Deciles, Percentiles and Mode (K1, K2, K3, K4)
2.4 Position of averages - Selection of the Appropriate Measure of Central Tendency (K1, K2)
2.5 Geometric mean (K1, K2, K3, K4)
2.6 Harmonic mean. (K1, K2, K3, K4)
(Chapter – 6: Section 6.1 – 6.9)

Unit III: Measures of Dispersion (18 hours)

3.1Introduction (K1)
3.2 Range (K1, K2, K3, K4)
3.3 Interquartile Range (K1, K2, K3, K4)
3.4 Mean deviation (K1, K2, K3, K4)
3.5 Variance and Standard deviation (K1, K2, K3, K4)
3.6 Alternate methods to find Standard Deviation-Coefficient of Variation. (K1, K2, K3, K4)
(Chapter – 7: Sections 7.1-7.7)

Unit IV: Probability (18 hours)

4.1 Introduction (K1)
4.2 The probability Scale (K1, K2)
4.3 Measurement of Probability (K1, K2)
4.4 Laws of probability for independent events (K1, K2, K3, K4)
4.5 Problems on probability (K1, K2, K3, K4)
4.6 Conditional probability (K1, K2, K3, K4)
(Chapter -8: Sections 8.1-8.5)

Unit V: Linear Regression and Correlation (18 hours)

5.1 Introduction (K1)
5.2 Scatter diagram (K1, K2)
5.3 Correlation and Regression (K1, K2)
5.4 Properties of Correlation and Regression (K1, K2)
5.5 Correlation Coefficient (Rank correlation coefficient) (K1, K2, K3, K4)
5.6 Regression Equations. (K1, K2, K3, K4)
(Chapter – 13: Sections 13.1 – 13.5)

Text Book:

1. P.S.S. Sundar Rao, J. Richard – An Introduction to Bio Statistics, 3rd Edition – Prentice Hall of India Pvt. Ltd., 2001.

Reference Books:

1. N. Gurumani – An introduction to Biostatistics, Second Edition – MJP Publishers, 2015.

2. Wayne W. Daniel, Chad L.Cross – Biostatistics, 10th Edition – Wiley India Pvt. Ltd., 2017.

3. P.Mariappan – Biostatistics, 1st Edition – Dorling Kindersley Pvt. Ltd., 2013.

e-Resources:

4. https://nptel.ac.in
5. www.coursera.org
6. https://swayam.gov.in

SEMESTER – IV
UABSB20 – Biostatistics II

Year: II **SEM:** IV	**Course Code:** UABSB20	**Title of the Course:** Biostatistics – II	**Course Type:** Theory	**Course Category:** Allied	**H/W** 6	**CREDITS** 5	**MARKS** 100

Course Objectives

1. To deepen the knowledge in various statistical concepts which play an important role in the field of biological sciences.
2. To understand interval estimation and hypothesis testing.
3. To interpret statistical results effectively in real life problems.

Course Outcomes (CO)

The learners will be able to

1. Apply probability distributions such as Binomial, Poisson and Normal to solve real life problems.
2. Recognize the importance of data collection and its role in determining scope of inference.
3. Execute the test of hypothesis for large and small samples drawn from a normal population.
4. Perform and apply Chi-square test
5. Carry out analysis of variance using F test.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	H	H	H	M	L
CO3	H	H	H	H	M	L
CO4	H	H	H	H	M	L
CO5	H	H	H	H	M	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	L	L	H
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

(Low-L, Medium - M, High - H)

Course Syllabus

Unit I: Probability Distributions **(18 hours)**

1.1 Introduction (K1)
1.2 Binomial distribution (K1, K2, K3, K4)
1.3 Binomial frequency distribution (K1, K2, K3, K4)
1.4 Poisson distribution (K1, K2, K3, K4)
1.5 Poisson frequency distribution (K1, K2, K3, K4)
1.6 Normal distribution. (K1, K2, K3, K4)
(Chapter – 9: Sections 9.1-9.4)

Unit II: Sampling **(18 hours)**

2.1Introduction (K1)
2.2 Definitions (K1)
2.3 Types of Population (K1, K2, K3)
2.4 Sample (K1, K2, K3, K4)
2.5 Sampling variation and Bias - Non-Probability Sampling Techniques (K1, K2, K3, K4)
2.6 Probability Sampling Techniques – Listing of Population - Sample size (K1, K2, K3, K4)
(Chapter – 10: Sections 10.1-10.9)

Unit III: Tests of significance and Estimation **(18 hours)**

3.1 Introduction (K1)
3.2 Procedure for Large Samples (K1, K2)
3.3 Problems based on large samples (K1, K2, K3, K4)
3.4 Procedure for Small samples: Examples (K1, K2, K3, K4)
3.5 Estimation: Example for Large Samples (K1, K2, K3, K4)
3.6 Estimation: Examples for Small Samples. (K1, K2, K3, K4)
(Chapter – 12: Sections 12.1-12.6)

Unit IV: The Chi Square Test **(18 hours)**

4.1 Introduction (K1)
4.2 The formula for Chi Square (K1, K2)
4.3 Distribution of Chi Square (K1, K2, K3)
4.4 Degrees of freedom (K1, K2, K3)
4.5 Some applications of Chi Square (K1, K2, K3, K4)
4.6 Misuse of Chi Square Test. (K1, K2)
(Chapter – 14: Sections 14.1-14.5)

Unit V: Analysis of Variance **(18 hours)**

5.1 Snedecor's F-Distribution (K1, K2, K3, K4)
5.2 Analysis of Variance (K1, K2, K3, K4)
5.3 One way classification - Completely Randomised Design (K1, K2, K3, K4)
5.4 Two way classification - Randomised Block Design (K1, K2, K3, K4)
5.5 Latin Square Design (K1, K2, K3, K4)
5.6 Merits and demerits of analysis of variance (K1, K2)
(Chapter - 13: Sections 13.19 – 13.20)

Text Books:

1. P. S. S. Sundar Rao, J. Richard – An Introduction to Bio Statistics, 3rd Edition – Prentice Hall of India Pvt. Ltd., 2001.

2. P. Mariappan – Biostatistics, 1st Edition – Dorling Kindersley Pvt. Ltd., 2013.

Reference Books:

1. N. Gurumani – An introduction to Biostatistics, Second Edition – MJP Publishers, 2015.

2. Wayne W. Daniel, Chad L. Cross – Biostatistics, 10th Edition – Wiley India Pvt. Ltd., 2017.

e-Resources:

1. https://nptel.ac.in
2. www.coursera.org
3. https://swayam.gov.in

SEMESTER – I
UAMST20 – Medical Statistics

Year: I **SEM:** I	**Course Code:** UAMST20	**Title of The Course :** Medical Statistics	**Course Type:** Theory	**Course Category:** Allied	**H/W** 5	**Credits** 5	**Marks** 100

Course Objectives

1. To introduce the basic concepts of statistics.
2. To make decisions based on statistical representation related to hospital administration.

Course Outcomes (CO)

The learners will be able to

1. Solve basic mathematical problems using matrices
2. Use various differentiation techniques
3. Give graphical representation of statistical data
4. Understand the concepts related to statistics
5. Analyze problems related to statistical measures

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	M	H	L
CO2	H	M	H	H	H	L
CO3	H	H	H	M	H	H
CO4	H	M	H	H	H	L
CO5	H	H	M	H	L	H

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	H	L
CO2	H	H	H	H	H	L
CO3	H	H	H	M	H	H
CO4	H	M	H	H	H	L
CO5	H	H	M	H	L	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Matrices **(15 hours)**

1.1 Definition - Types of matrices (K1, K2)
1.2 Matrix operations - Determinant of a matrix (K1, K2, K3, K4)
1.3 Singular and non-singular matrices (K1, K2, K3, K4)
1.4 Inverse of a matrix by co-factor method (K1, K2, K3, K4)
1.5 Rank of a matrix (K1, K2, K3, K4)
1.6 Solution of system of linear simultaneous equations using Cramer's rule (K1, K2, K3, K4)

Unit II: Differentiation **(15 hours)**

2.1 Derivatives of standard functions x^n, e^x, log x, constant (without proof) (K1, K2, K3)
2.2 Rules of differentiation (Addition, difference, product, quotient) (K1, K2, K3, K4)
2.3 chain rule, Successive differentiation (up to 2^{nd} derivative) (K1, K2, K3, K4)
2.4 Uses: Marginal Concepts, Elasticity of demand (K1, K2, K3, K4)
2.5 Increasing and decreasing functions (K1, K2, K3, K4)
2.6 maxima and minima – break - even point (K1, K2, K3, K4)

Unit III: Classification and Graphical Representation **(15 hours)**

3.1 Introduction - meaning of classification - chief characteristics of classification (K1, K2)
3.2 Objects of classification - rules of classification (K1, K2)
3.3 Frequency distributions (K1, K2, K3, K4)
3.4 Cumulative frequency distribution - bivariate frequency distributions (K1, K2, K3, K4)
3.5 Graph of frequency distribution - histogram (K1, K2, K3, K4)
3.6 frequency polygon - frequency curve (K1, K2, K3, K4)

Unit IV: Measures of Central Tendency **(15 hours)**

4.1 Arithmetic mean (K1, K2, K3, K4)
4.2 Median (K1, K2, K3, K4)
4.3 Mode – Empirical formulae (K1, K2, K3, K4)
4.4 Combined and Weighted arithmetic mean (K1, K2, K3, K4)
4.5 Geometric mean (K1, K2, K3, K4)
4.6 Harmonic mean (K1, K2, K3, K4)

Unit V: Measures of Dispersion and Skewness **(15 hours)**

5.1Range - quartile deviation (K1, K2, K3, K4)
5.2 mean deviation (K1, K2, K3, K4)
5.3 Standard deviation (K1, K2, K3, K4)
5.4 Karl Pearson's and Bowley's coefficient of Skewness (K1, K2, K3, K4)
5.5 Correlation (K1, K2, K3, K4)
5.6 Regression (K1,K2, K3, K4)

Text Books:

1. P.A. Navnitham - Business Mathematics and Statistics, Jai Publishers, Trichy, 2023.
2. R.S.N. Pillai and Bagavathi – Statistics, S. Chand and Company, New Delhi, 17th Edition

Reference Books:

1. Asim Kumar Manna - Business Mathematics & Statistics. McGraw Hill Education (India) Pvt. Ltd., 2018.
2. Statistical Methods - S.P. Gupta, Sultan Chand, 2012.
3. Francis, Andy - Business mathematics and statistics. Cengage Learning EMEA, 2004.
4. Agarwal, B. M. - Business Mathematics & Statistics. Ane Books Pvt Ltd, 2009.
5. Dr. P.R. Vittal - Mathematical Statistics, Margam Publications, 2015.

e-Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – II
UAORA20 – Operations Research

Year: I **SEM:** II	**Course Code:** UAORA20	**Title Of The Course :** Operations Research	**Course Type :** Theory	**Course Category:** Allied II	**H/W** 5	**Credits** 5	**Marks 100**

Course Objectives

1. To introduce the techniques of solving problems in the field of industry, marketing and finance
2. To create awareness about optimization in the utility of resources

Course Outcomes (CO)

The learners will be able to

1. Understand the basic operations research concepts and solve linear programming problems.
2. Analyze real-life situation using transportation models.
3. Assign jobs to different machines using assignment models.
4. Use knowledge of Network Analysis in Hospital Administration.
5. Acquire wide knowledge in Game Theory.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	H
CO2	H	H	H	M	L	H
CO3	M	L	H	H	H	H
CO4	M	L	H	H	H	H
CO5	H	H	M	H	H	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	M	L	M	H
CO2	H	H	H	M	L	H
CO3	M	L	H	M	L	H
CO4	M	L	H	L	M	H
CO5	H	H	M	M	L	H

(L-Low, M-Moderate, H-High)

Course Syllabus

Unit I: Introduction and Linear Programming (15 hours)

1.1 Operations research
1.2 : Definition – Scope (K1, K2)
1.3 Characteristics (K1, K2)
1.4 Linear programming (K1,K2)
1.5 Formulation (K1,K2, K3)
1.5 Graphical method (K1, K2, K3, K4)
1.6 Regular simplex method (Simple Problems) (K1, K2, K3, K4)

Unit II: Transportation Model (15 hours)

2.1 Transportation Problem – Introduction (K1, K2)
2.2 Initial basic feasible solution (North West Corner) (K1, K2, K3, K4)
2.3 Initial basic feasible solution (Least Cost VAM) (K1, K2, K3, K4)
2.4 Unbalanced Transportation problem (K1, K2, K3, K4)
2.5 Maximization problem (K1, K2, K3, K4)
2.6 Test of Optimality using MODI method (excluding Degeneracy) (K1, K2, K3, K4)

Unit III: Assignment Model (15 hours)

3.1 Assignment problem – Introduction (K1, K2)
3.2 Minimal assignment problem - Balanced (K1, K2, K3, K4)
3.3 Minimal assignment problem - Unbalanced (K1, K2, K3, K4)
3.4 Restricted Assignment problem (K1, K2, K3, K4)
3.5 Maximization problem – Balanced (K1, K2, K3, K4)
3.6 Maximization problem – Unbalanced (K1, K2, K3, K4)

Unit IV: Network Analysis: CPM and PERT Computations (15 hours)

4.1Construction – The Network – Numbering the events (K1, K2)
4.2 Different time calculations – representation in tabular form (K1, K2, K3, K4)
4.3 Total, Independent and Free float (K1, K2, K3, K4)
4.4 Calculation of critical path and project duration (K1, K2, K3, K4)
4.5 Basic steps in PERT – Difference between CPM and PERT (K1, K2, K3, K4)
4.6 Calculation of critical path and project duration (K1, K2, K3, K4)

Unit V: Game Theory (15 hours)

5.1 Game theory – Meaning – Saddle point (K1, K2)
5.2 Pure Strategy (K1, K2, K3, K4)
5.3 Mixed Strategy (K1, K2, K3, K4)
5.4 Dominance property (K1, K2, K3, K4)
5.5 Solving 2 x m game using graphical method (excluding L.P.P) (K1, K2, K3, K4)
5.6 Solving n x 2 game using graphical method (excluding L.P.P) (K1, K2, K3, K4)

Text Books:

1. Premkumar Gupta and Hira D.S. - Introduction to Operations Research, 1st Edition – S.Chand Company Ltd., 1998.

2. Vittal P.R - Introduction to Operations Research, 1st Edition - Margham Publishers – 1999.

3. V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan, "Resource Management Techniques" A.R. Publications, 2009.

Reference Books:

1. Kalavathy. S - Operations Research, 4th Edition, Vikas Publishing Ltd., 2013

2. K. Pandian, C.Kayalvizhi - Applied Operations Research for Management, 2nd Edition, Thirumalaa Publications, 2004

3. R.Paneerselvam - Operation Research, PHI Learning Pvt. Ltd., 2nd Edition 2006

e -Resources:

1. www.coursera.org/
2. https://nptel.ac.in/
3. https://swayam.gov.in/

SEMESTER – V / VI
UGMAAn20 - Mathematics for Competitive Examinations

Year: III **SEM:** V / VI	**Course Code:** UGMAAn20	**Title of the Course:** Mathematics for Competitive Examinations	**Course Type:** Theory	**Course Category:** Non-Major Elective	**H/W** 3	**CREDITS** 3	**MARKS** 100

Course Objectives

1. To revitalize the basic knowledge of mathematics and problem solving skills.
2. To enhance logical, analytical and critical thinking of learners.
3. To help the learners to acquire satisfactory competency using verbal and nonverbal reasoning
4. To help the students to prepare for various competitive examinations.

Course Outcomes (CO)

The learners will be able to

1. Gain critical thinking and numerical ability to solve problems.
2. Apply the concepts of quantitative aptitude to solve real life problems.
3. Interpret and use data represented in different forms
4. Reason out verbally and non-verbally
5. Write various competitive exams for higher studies and jobs

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	L	L
CO5	H	M	H	H	L	L

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

(L-Low, M-Moderate, H-High)

Course Syllabus

UNIT I: Numerical Ability **(9 hours)**

Numbers, H.C.F. & L.C.M. of Numbers, Simplification, Decimal Fractions, Square Roots & Cube Roots, Averages, Percentage, Ratio and Proportion. (K1, K2, K3, K4)

UNIT II: Numerical Ability (Continued) **(9 hours)**

Ages, Time and Work, Time and Distance, Profit and Loss,Simple Interest, Compound Interest, Permutation &Combination, Probability (K1, K2, K3, K4)

UNIT III: Data Interpretation **(9 hours)**

Tabulation, Bar Graphs, Pie Charts, Line graphs (K1, K2, K3, K4)

UNIT IV: Verbal Reasoning **(9 hours)**

Series, Classification, Coding - Decoding, Blood Relations, Puzzles (K1, K2, K3, K4)

UNIT V: Verbal Reasoning (Continued) **(9 hours)**

Direction Sense Test, Alphabet test, Ranking and Time sequence test, Statements & Arguments, Statements & Conclusions (K1, K2, K3, K4)

Text Books:

1. Dr. R. S. Aggarwal – A Modern Approach to Verbal and Non-Verbal Reasoning –Revised Edition – 2019 – S. Chand and Co.

2. Dr. R. S. Aggarwal – Quantitative Aptitude – Seventh Edition – S. Chand and Co., 2019

Reference Books:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, McGraw Education Series, 5th Edition 2019

2. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, Pearson India, Edition 2019.

3. Sarvesh K. Verma, Quantitative Aptitude Quantum CAT 2018, Arihant publication, Edition 2018.

e-Resources:

1. https://nptel.ac.in/
2. www.coursera.org
3. www.indiabix.com

ASSESSMENT METHODS

1. For Allied Papers

Semester Examination (100 Marks)
Time: 3 Hours

Section A – 10 x 2 = 20 marks
Answer **all** questions
10 questions (2 questions from each unit)

Section B – 5 x 7 = 35 marks
Answer **all** questions
5 questions with internal choice (1 question from each unit)

Section C – 3 x 15 = 45 marks
Answer **any three** questions
5 questions (1 question from each unit)

CA Examination (50 Marks)
Time: 1 Hour 30 Minutes

Section A – 7 x 2 = 14 marks
Answer **all** questions
7 questions

Section B – 3 x 7 = 21 marks
Answer **any three** questions
3 out of 5 questions

Section C– 1 x 15 = 15 marks
Answer **any one** question
2 questions (1 question from each unit)

For NME: Mathematics for Competitive Examinations

Semester Examination (100 Marks)
Time: 3 Hours

100 multiple choice questions (1 mark for each question)

CA Examination (50 Marks)
Time: 1 Hour 30 Minutes

50 multiple choice questions (1 mark for each question)