Dr. AMBEDKAR GOVERNMENT ARTS COLLEGE
(AUTONOMOUS)
CHENNAI - 600 039

(Accredited by NAAC at level "B")

B. Sc. (MATHEMATICS)

(FOR CANDIDATES ADMITTED FROM 2022-23 ONWARDS)

Syllabus

Under Choice Based Credit System

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (LOCF)

PG & RESEARCH DEPARTMENT OF MATHEMATICS

Based on UGC – Learning Outcomes-Based Curriculum Framework

Course Structure under Choice Based Credit System

(For the candidates admitted from the academic year 2022-2023 onwards)

Sem. No.	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
I	I	LC - I	22UAFTA1	General Tamil - I	6	3	3	25	75	100
	II	ELC - I	22UACEN1	Communicative English - I	4	3	3	50	50	100
	III	CC - I	22UAMAC1	Classical Algebra and Number Theory	5	4	3	25	75	100
	III	CC - II	22UAMAC2	Calculus	4	4	3	25	75	100
	III	AC - I	22UACHA1	Allied Chemistry –I	4	3	3	25	75	100
	III	ACP *	Even Sem.	Allied Chemistry Practical	3	-	-	40	60	100
	IV	NME - I		One from the Non Major Elective Subjects from other departments	2	2	3	25	75	100
	IV	SBE - I	22UAPPS1	Professional English for Physical Science - I	2	3	3	50	50	100
				Total	**30**	**22**				
II	I	LC - II	22UBFTA2	General Tamil - II	6	3	3	25	75	100
	II	ELC - II	22UBCEN2	Communicative English - II	4	3	3	50	50	100
	III	CC - III	22UBMAC1	Trigonometry and Analytical Geometry – three dimensional	5	4	3	25	75	100
	III	CC - IV	22UBMAC2	Laplace Transforms and Fourier Series	4	4	3	25	75	100
	III	AC - II	22UBCHA2	Allied Chemistry – II	4	3	3	25	75	100
	III	ACP - III	22UBCHA3	Allied Chemistry Practical	3	4	3	40	60	100
	IV	NME - II		One from the Non Major Elective Subjects from other departments	2	2	3	25	75	100
	IV	SBE - II	22UBPPS2	Professional English for Physical Science -II	2	3	3	50	50	100
				Total	**30**	**26**				

Sem. No.	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
III	I	LC - III	22UCFTA3	General Tamil - III	6	3	3	25	75	100
	II	ELC - III	22UCLTS1	Language Through Literature - I	4	3	3	50	50	100
	III	CC - V	22UCMAC1	Differential Equations	4	4	3	25	75	100
	III	CC - VI	22UCMAC2	Mathematical Statistics	5	4	3	25	75	100
	III	AC - IV	22UCPHA1	Allied Physics – I	4	3	3	25	75	100
	III	ACP**	Even Sem.	**Allied Physics Practical**	3	-	-	40	60	100
	IV	EVS	22UCEVS1	Environmental Studies	2	2	3	25	75	100
	IV	SBE - III	22UCSBE3	SS III – Personality Enrichment	2	3	3	40	60	100
				Total	**30**	**22**				
IV	I	LC - IV	22UDFTA4	General Tamil - IV	6	3	3	25	75	100
	II	ELC - IV	22UDLTS2	Language Through Literature - II	4	3	3	50	50	100
	III	CC - VII	22UDMAC1	Vector Calculus	4	4	3	25	75	100
	III	CC - VIII	22UDMAC2	Mechanics – I	5	4	3	25	75	100
	III	AC - V	22UDPHA2	Allied Physics – II	4	3	3	25	75	100
	III	ACP - VI	22UDPHA3	**Allied Physics Practical**	3	4	3	40	60	100
	IV	VBE	22UDVBE1	Value Based Education	2	2	3	25	75	100
	IV	SBE - IV	22UDSBE4	Computer Basics and Office Automation	2	3	3	40	60	100
	V	Extension	22UDEXT1	Extension Activities	-	1	-	-	-	-
				Total	**30**	**27**				
V	III	CC - IX	22UEMAC1	Abstract Algebra	6	4	3	25	75	100
	III	CC - X	22UEMAC2	Real Analysis – I	6	4	3	25	75	100
	III	CC - XI	22UEMAC3	Mechanics – II	6	4	3	25	75	100
	III	CC - XII	22UEMAC4	Operations Research	6	4	3	25	75	100
	III	CEC - I	#	One from the Elective-I Subjects	6	5	3	25	75	100
				Total	**30**	**21**				

Sem. No.	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
VI	III	CC - XIII	22UFMAC1	Linear Algebra	6	4	3	25	75	100
	III	CC - XIV	22UFMAC2	Real Analysis – II	6	4	3	25	75	100
	III	CC - XV	22UFMAC3	Complex Analysis	6	4	3	25	75	100
	III	CEC - II	##	One from the Elective-II Subjects	6	5	3	25	75	100
	III	CEC - III	###	One from the Elective-III Subjects	6	5	3	25	75	100
				Total	**30**	**22**				
				Total	**180**	**140**				

***- Practical Exam at the end of second semester**

****- Practical Exam at the end of fourth semester**

CORE ELECTIVE COURSES:

Elective-I (Any one subject of the following Core Elective chosen by the candidate)		**Elective-II** (Any one subject of the following Core Elective chosen by the candidate)		**Elective-III** (Any one subject of the following Core Elective chosen by the candidate)	
#Sub. Code	**Core Elective Courses**	**##Sub. Code**	**Core Elective Courses**	**###Sub. Code**	**Core Elective Courses**
22UEMAE1A	Numerical Methods	22UFMAE2A	Graph Theory	22UFMAE3A	Resource Management Techniques
22UEMAE1B	Discrete Mathematics	22UFMAE2B	Elementary Number Theory	22UFMAE3B	Partial Differential Equations with Applications

ALLIED COURSES:

I Semester		**II Semester**	
Sub. Code	**Allied Course**	**Sub. Code**	**Allied Course**
22UAMAA1	Allied Mathematics – I	**22UBMAA2**	Allied Mathematics – II

NON MAJOR ELECTIVE COURSE:

I Semester (Any one subject of the following Non Major Elective chosen by the candidates of other departments)		**II Semester** (Any one subject of the following Non Major Elective chosen by the candidates of other departments)	
Sub. Code	**Non Major Elective**	**Sub. Code**	**Non Major Elective**
22UAMAN1A	Analytical Skills and Aptitude	22UBMAN2A	Functional Mathematics
22UAMAN1B	Descriptive Statistics	22UBMAN2B	Functional Statistics

SEMESTER - I

B.Sc. Degree Programme in Mathematics

First Semester				
Course Title		**CLASSICAL ALGEBRA AND NUMBER THEORY**		
Course Code		**22UAMAC1**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC I	**Core**	**4**	**5**	**25 + 75=100**

Course objectives:

- To understand and identify the various types of square matrices.
- To find eigen values and eigen vectors, apply Cayley-Hamilton theorem for finding powers of square matrices.
- To understand the relation between the roots and the coefficients of the polynomial equations.
- To familiarize the transformation of equations.
- To grasp the fundamental theorem of arithmetic and its applications, learn the Euler's ∅-function.

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

Symmetric, skew symmetric, Hermitian, Skew Hermitian, Orthogonal and unitary matrices. Cayley- Hamilton theorem (Without proof) – Eigen values, Eigen vectors.

Unit II: Theory of equations: **(15 hours)**

Formation of equations - Polynomial equations imaginary and irrational roots - Relations between roots and coefficients - symmetric functions of roots in terms of coefficients.

Unit III: Reciprocal equations: **(15 hours)**

Transformation of equations – multiplication of roots, diminishing the roots – Descartes rule of signs - Approximate solution of roots by Horner's method.

Unit IV : Theory of numbers: **(15 hours)**

Divisibility of integers – Division Algorithm – GCD – Euclidian algorithm – prime numbers – composite numbers – fundamental theorem of arithmetic (without proof) – divisors of a positive integer N –

Unit V: Theory of numbers (continued…): **(15 hours)**

Euler's function $\phi(N)$ – formula for $\phi(N)$ (without proof) – highest power of prime *p* contained in n!.

Reference Books :

1. T.K. Manicavachogam Pillay, T. Natarajan and K.S.Ganapathy, "Algebra", Viswanathan S Publishers and Printers Pvt Ltd., - 2004.
2. Kandasamy, P and K. Thilagavathy – "Mathematics for B.Sc., - 2004", S.Chand and Co., New Delhi.
3. P.R. Vittal, "Algebra and Trigonometry", Margam Publications.
4. Arumugam S., Thangapandi Isaac A., "Classical Algebra", New Gamma Publishing House, Palayamkottai.
5. David N. Burton, "Elementary Number Theory", 6th Edition, Tata McGraw Hill Publishers, 2008.
6. S. J. Venkatesan, "Algebra", Sri Krishna Publications, Chennai – 77.

Web Resources:

- https://nptel.ac.in/

- https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Recall matrices and the operations on them, identify various types of square matrices and evaluate the powers of square matrices.	**K1, K2, K3, K4**
CO2	Find the roots of certain types polynomial equations.	**K1, K2, K3, K4**
CO3	Find an approximate solution of polynomial equations	**K1, K2, K3, K4**
CO4	Find the divisors of an integer.	**K1, K2, K3, K4**
CO5	Find the highest power of a prime in	**K1, K2, K3, K4**
K1 – Remembering, **K2**– Understanding, **K3** –Applying,**K4** –Analysing, **K5**–Evaluating, **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One questions from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

First Semester				
Course Title		**CALCULUS**		
Course Code		**22UAMAC2**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC II	**Core**	**4**	**4**	**25 + 75=100**

Course objectives:

- To recall the concept of differentiation and to evaluate the higher order derivatives.
- To assimilate the concept of curvature and to find radius of curvature of various curves.
- To find envelops of a family, asymptotes of a curve and write p-r equations.
- To learn Jacobian and its properties.
- To calculate maxima and minima of functions of two and three variables.

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

Introduction to differentiation - nth derivatives, Leibnitz's theorem and its applications.

Unit II: Curvature and radius of curvature: **(12 hours)**

Radius of curvature in Cartesian, Parametric and Polar coordinates – simple problems.

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

Envelopes and Asymptotes, pedal equations.

Unit IV: Partial differentiation: **(12 hours)**

Jacobians, maxima and minima of functions of 2 and 3 variables, Lagrange's method – simple problems.

Unit V: Multiple integrals: **(12 hours)**

Double and triple integrals- change of order – simple problems (no applications)

Reference Books:

1. Narayanan, S and T.K. Manickavasagam Pillai, "Calculus", Volume I (2004), Volume II (2004), S.Viswanathan Printers Pvt. Ltd., Chennai.
2. P.R.Vittal and V.Malini, "Calculus and Differential Geometry", Margham Publications, Chennai.
3. Kandasamy, P and K Thilagavathy, "Mathematics for B.Sc., - Volume II – 2004", S.Chand & Co., New Delhi.
4. Arumugam S., Thangapandi Isaac A., "Calculus", New Gamma Publishing House, Palayamkottai.
5. S. J. Venkatesan, "Differential Calculus", Sri Krishna Publications, Chennai – 77.
6. S. J. Venkatesan, "Integral Calculus", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Seminars.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Compute *n*th derivatives.	**K1, K2, K3, K4**
CO2	Find radius of curvature of a curve in Cartesian coordinates.	**K1, K2, K3, K4**
CO3	Find asymptotes and p-r equations of curves.	**K1, K2, K3, K4**
CO4	Adept in optimization of functions of two and three variables.	**K1, K2, K3, K4**
CO5	Evaluate double and triple integrals.	**K1, K2, K3, K4**
K1 – Remembering, **K2**– Understanding, **K3** –Applying,**K4** –Analysing, **K5**–Evaluating, **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One questions from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER - II

B.Sc. Degree Programme in Mathematics

Second Semester				
Course Title		**TRIGONOMETRY AND ANALYTICAL GEOMETRY-THREE DIMENSIONAL**		
Course Code		**22UBMAC1**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC III	**Core**	**4**	**5**	**25 + 75=100**

Course objectives:

- To series expand trigonometric functions.
- To understand hyperbolic functions and logarithm of complex numbers.
- To study the equation of a sphere, its geometric properties.
- To develop the skills for solving problems related to cone and right circular cylinder.

Unit I: Expansion of trigonometric functions: (15 hours)

Expansion of $\sin nx$, $\cos nx$, $\tan nx$, $\sin^n x$, $\cos^n x$, Expansion of $\sin x$, $\cos x$ and $\tan x$ in ascending powers of x.

Unit II: Hyperbolic functions and inverse hyperbolic functions: (15 hours)

Hyperbolic functions - Definition, Relation between Hyperbolic functions, Inverse Hyperbolic functions, Logarithm of complex quantities.

Unit III: Sphere: (15 hours)

Tangent Plane - Circle of intersections - Tangency of Spheres - Coaxial System of Spheres - Radical Planes - Orthogonal Spheres.

Unit IV: Cone: (15 hours)

Equation of a Cone - Cone with Vertex at the origin - Quadratic cone with the vertex at the origin.

Unit V: Cylinder: (15 hours)

Right circular cylinder.

Text Books:

1. T. K. Manicavachogam Pillai and T. Natarajan, "Trigonometry", S. Viswanathan Publishers and Printers Pvt. Ltd. Chennai.
2. T. K. Manicavachogam Pillai and T. Natarajan, "Analytical Geometry 3 – dimensions", S. Viswanathan Publishers and Printers Pvt. Ltd. Chennai.

Reference Books :

1. Duraipandian. P., Laxmi Duraipandian and D. Jayamala Paramasivan, "Trigonometry", Emerald Publishers, Chennai.
2. Arumugam S., Thangapandi Isaac A., "Trigonometry", New Gamma Publishing House, Palayamkottai
3. Duraipandian. P., Laxmi Duraipandian and D.Muhilan (Revised Edition - Reprint - 2003) "Analytical Geometry (Three Dimensions)", Emerald Publishers.
4. S. J. Venkatesan, "Trigonometry", Sri Krishna Publications, Chennai – 77.
5. S. J. Venkatesan, "Analytical Geometry 3D", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Expand trigonometric functions as a series.	**K1, K2, K3, K4**
CO2	Classify hyperbolic and inverse hyperbolic functions.	**K1, K2, K3, K4**
CO3	Analyze and Explain about the Tangent Plane and Radical planes.	**K1, K2, K3, K4**
CO4	Find equations of cone, quadratic cone with various conditions.	**K1, K2, K3, K4**
CO5	Find equations of right circular cylinder with various conditions.	**K1, K2, K3, K4**
K1 – Remembering, **K2**– Understanding, **K3** –Applying,**K4** –Analysing, **K5**–Evaluating, **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One questions from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Second Semester				
Course Title		**LAPLACE TRANSFORMS AND FOURIER SERIES**		
Course Code		**22UBMAC2**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC IV	**Core**	**4**	**4**	**25 + 75=100**

Course objectives:

- To understand Laplace Transforms and its properties, find Laplace Transform of simple functions.
- To Learn inverse Laplace Transforms, finds inverse Laplace Transforms of certain functions.
- To Summarize the formulae of Laplace Transform and inverse Laplace Transforms and applies it to solve second order ODE.
- To define and understand Fourier series and could expand functions as a Fourier series.

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

Definition and properties-Laplace transform of some elementary, e^{at},cosat,sinat, coshat, sinhat, t^n, $e^{at}f(t)$, $t^nf(t)$, f(t)/t, $f^{(n)}(t)$, $\int_0^t f(t)dt$ -simple problems.

Unit II: Inverse Laplace Transforms: **(12 hours)**

Some standard functions – simple problems.

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

Solving ordinary differential equations of 2^{nd} order with constant coefficients.

Unit IV: Fourier series: **(12 hours)**

Definition, Fourier series expansion for a given periodic function in $(0,2\pi)$ and $(-\pi, \pi)$.

Unit V: Fourier series (continued…): **(12 hours)**

Fourier series for odd and even functions in $(-\pi, \pi)$ – Half-range series.

Reference books:

1. Narayanan S and T.K.Manicavachogam Pillay, “Calculus”, Viswanathan S Publishers, Chennai.
2. P.R.Vittal and V.Malini, “Calculus and Differential Geometry”, Margham Publications, Chennai.
3. M. K. Venkataraman, “Engineering Mathematics – III”, National Publishing House, Chennai.
4. S. J. Venkatesan, “Transform Techniques”, Sri Krishna Publications, Chennai – 77.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Define Laplace Transforms, summarize its properties, evaluate Laplace Transforms of simple functions.	**K1, K2, K3**
CO2	Find the Inverse Laplace Transforms of simple functions.	**K1, K2, K3**
CO3	Recall the formulae pertaining Laplace Transforms and inverse Laplace Transforms. Apply Laplace Transform in solving ordinary differential equations.	**K1, K2, K3, K5**
CO4	Elaborate on Fourier series expansions, Find Fourier series of some periodic functions.	**K1, K2, K3, K6**
CO5	Define odd and even functions, could expand them as Fourier series and learn half - range series.	**K1, K2, K3,K4,K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One questions from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER - III

B.Sc. Degree Programme in Mathematics

Third Semester				
Course Title		**DIFFERENTIAL EQUATIONS**		
Course Code		**22UCMAC1**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC V	**Core**	**4**	**4**	**25 + 75=100**

Course objectives:

- To learn different methods of solving first order but of higher degree differential equations.
- To identify and solve the different types of second order differential equations with constant coefficients.
- To solve the second order differential equations with variable coefficients.
- To solve some standard types of partial differential equations.
- To solve Lagrange's equation and learn Charpit's method.

Unit I: First order differential equations but of higher degree: (12 hours)
Solvable for *p*, solvable for *x*, solvable for *y*, Clairaut's form, exact differential equations.

Unit II: Second order ordinary differential equations with constant coefficients: (12 hours)
RHS of the form $e^{ax}V$ where V is x^m(*m* is a positive integer), Cos*bx*, Sin*bx*.

Unit III: **Second order ordinary differential equations with variable coefficients**: **(12 hours)**
Method of variation of parameters – simple problems.

Unit IV: Partial differential equations: (12 hours)
Formation by eliminating arbitrary constants and arbitrary functions; complete integral; singular integral; general integral; the standard types $f(p,q) = 0$, $f(x,p,q) = 0$, $f(y,p,q) = 0$, $f(z,p,q) = 0$, $f(x,p) = f(y,p)$; Clairaut's form.

Unit V: Partial differential equations (continued…): (12 hours)
Lagrange's equation Pp + Qq = R , Charpit's method– simple problems.

Reference Books:

1. S. Narayanan,T.K. Manicavachogam Pillay, "Differential Equations and its applications", Viswanathan S publications.
2. P.R. Vittal, V.Malini, "Differential equations and Laplace Transforms", Margam Publications.
3. P.Kandasamy, K. Thilagavathi, "Mathematics for B.Sc., Vol III-2004", S.Chand and Co., New Delhi.
4. Arumugam S., and Isaac A., "Differential Equations and Applicatoins", New Gamma Publishing House, Palayamkottai, 2014.
5. S. J. Venkatesan, "Differential Equations", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. http://mathworld.wolfram.com
2. https://nptel.ac.in/
3. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Solve first order higher degree differential equations.	**K1, K2, K3**
CO2	Find the solution of second order differential equations with constant coefficients.	**K1, K2, K3**
CO3	Find the solution of second order differential equations with variable coefficients.	**K1, K2, K3**
CO4	Evaluate solution of standard types of partial differential equations.	**K1, K2, K3**
CO5	Learns solutions of Lagrange's equation and Charpit's method.	**K1, K2, K3**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	2	2	2	1
CO2	3	2	2	2	2	1
CO3	3	2	2	2	2	2
CO4	3	2	2	2	2	2
CO5	3	2	2	2	2	2
Total	15	9	10	10	10	8
Average	3	1.8	2	2	2	1.6

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One questions from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Third Semester				
Course Title		**MATHEMATICAL STATISTICS**		
Course Code		**22UCMAC2**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC VI	**Core**	**4**	**5**	**25 + 75=100**

Course objectives:

- To understand the concepts of mathematical expectations, marginal and conditional distributions and their applications.
- To understand the concepts of chi-square distribution, student's t-distribution and F-distribution and their applications.
- To understand the concepts of moment generating function technique and the central limit theorem.
- To enable the use of statistical, graphical and algebraic techniques wherever relevant.

Unit I: Random Variables: (15 hours)

Distribution functions - Discrete random variable - Continuous random variable - Joint Probability mass function - Joint Probability distribution function - Marginal distribution function - Joint density function -conditional distribution function.

Unit II: Mathematical Expectation: (15 hours)

Addition and Multiplication theorem - Covariance Expectation and variance of linear combination of random variables - Moment generating function - Characteristic function.

Unit III: Sampling Distributions: (15 hours)

Testing statistical hypothesis - Null and alternate hypothesis – Type I and Type II errors – Powers of a test – Critical region – Level of significance – One/two tailed tests - critical value.

Large sample test: Test of significance for single mean and difference of means.

Unit IV: Small sample tests: (15 hours)

Student's t-distribution. Tests based on t - distribution (single mean, difference of means and paired t-test).

Unit V: Small sample tests (continued…): (15 hours)

F-distribution - χ^2 - distribution (Definition only), test for difference of two variances, independence of attributes.

Text Book:

Gupta.S.C.& V.K. Kapoor – Fundamentals of Mathematical statistics – 2002 Sultan Chand & Sons, New Delhi – Eleventh thoroughly revised edition.

Reference Books:

1. Kandasamy, P.K.Thilagavathy and K. Gunavathi, Probability, Statistics and Queueing theory – (2007) S.Chand and Co., New Delhi.
2. Vittal.P.R. Mathematical Statistics – 2004 – Maragatham Publishers.
3. Arumugam and Isaac-Statistics, New Gamma Publishing House, 2016.

4. Veerarajan T. Fundamentals of Mathematical Statistics, yes dee Publishing Private Ltd. 2017.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Apply Distribution functions and analyze the problems based on Joint Probability mass function -Joint Probability distribution function - Marginal distribution function - Joint density function -conditional distribution function	**K1, K2, K3, K4**
CO2	Simplify and choose the problems in Mathematical expectations.	**K1, K2, K3, K4**
CO3	Understand the basics of sampling distributions and explore the concepts of testing of hypothesis.	**K1, K2**
CO4	Infer the results from single mean, two means and paired t-test problems using t-distribution.	**K1, K2, K3, K4, K5**
CO5	Infer the results from two variance problems using F-distribution and independence of attributes problems using χ^2 - distribution	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	1
CO2	3	3	2	1	3	2
CO3	3	3	2	1	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	2	2	1
Total	15	14	10	8	11	8
Average	3	2.8	2	1.6	2.2	1.6

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER– IV

B.Sc. Degree Programme in Mathematics

Fourth Semester				
Course Title		**VECTOR CALCULUS**		
Course Code		**22UDMAC1**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC VII	**Core**	**4**	**4**	**25 + 75=100**

Course objectives:

- To understand and illustrate both scalar and vector point functions and their derivatives. Summarize the algebra of vector differentiation.
- To explain the concepts of grad, div and curl. Outline their physical & geometrical meanings and applications.
- To summarize various vector identities and solve simple problems.
- To understand and demonstrate vector integration.
- To learn integral theorems, interpret them and verify them.

Unit I: Vector Differentiation: **(12 hours)**

Vector point function - Scalar point function – Derivative of vector and derivative of sum of vectors – derivative of product of scalar and vector point function – derivative of scalar and vector product.

Unit II: Gradient, divergence and Curl: **(12 hours)**

Introduction - The vector operator ∇ - Gradient of a scalar point function - Divergence of a vector - Curl of a vector - Definitions of solenoidal and irrotational vectors, directional derivative, unit normal to the surface, tangent and normal plane.

Unit III: **Vector Identities:** **(12 hours)**

Laplacian operator – vector identities – simple problems.

Unit IV: **Vector Integration:** **(12 hours)**

Line integral - Surface integral - Volume integral.

Unit V: **Integral Theorems:** **(12 hours)**

Stokes Theorem, Gauss-divergence Theorem, Green's Theorem in two dimensions (all theorems statement only) – simple problems.

Reference Books:

1. S. Narayanan, T.K. Manicavachogam Pillay, "Vector analysis", Viswanathan S publications, Chennai.
2. Duraipandian P, Laxmi Duraipandian, "Vector Analysis", Emerald Publishers, Chennai.
3. P.R.Vittal and Malini, "Vector Analysis", Margham Publishers, Chennai.
4. S. J. Venkatesan, "Trigonometry and Vector Calculus", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Recall the basics of vectors. Understand and illustrate both scalar and vector point functions and their derivatives. Summarize the algebra of vector differentiation.	K1, K2
CO2	Explain the concepts of grad, div and curl. Analyze their physical & geometrical meanings and applications, find directional derivatives and normals to surfaces and classify as to whether the field is solenoidal or irrotational.	K2,K3,K4
CO3	Summarize various vector identities; apply them to solve simple problems.	K2,K3
CO4	Recall the concept of multiple integrals, demonstrate the understanding and evaluation of line, surface and volume integrals, and adapt them to solve some geometrical & physical problems.	K1,K2,K5
CO5	Apply the knowledge of vector integration to understand integral theorems meaningfully, interpret the relationship between line, surface, volume integrals, and examine in some simple situations.	K1,K2,K4,K5
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	1	2	1	1
CO2	3	1	2	2	1	1
CO3	3	1	1	2	1	1
CO4	3	2	2	2	1	1
CO5	3	2	2	2	1	1
Total	15	7	8	10	5	5
Average	3	1.4	1.6	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Fourth Semester				
Course Title		**MECHANICS-I**		
Course Code		**22UDMAC2**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC VIII	**Core**	**4**	**5**	**25 + 75=100**

Course objectives:

- To learn the application of geometric properties in equilibrium of particles.
- To acquire knowledge of Moments and Parallel forces.
- To define and explain Moment of a couple, arm and axis of a couple.
- To have in depth understanding of friction.
- To understand the Centre of mass.

Unit I: Force: (15 hours)

Newton's laws of motion: Forces – Types of forces, Resultant of two forces on a particle: Resultant of three forces related to a triangle acting at a point – Resultant of several forces acting on a particle.

Equilibrium of a particle: equilibrium of a particle under three forces -under several forces.

(Sections: 2.1, 2.2, 3.1)

Unit II: Forces on a rigid body: (15 hours)

Moment of a force: moment of a force about a line - scalar moment, Parallel forces: point of application of resultant of many parallel forces – Varignon's theorem - parallel forces at the vertices of a triangle, forces along the sides of a triangle – simple Problems.

(Sections: 4.1, 4.4, 4.5)

Unit III: Forces on a rigid body (continued…): (15 hours)

Couples: moment of a couple - arm and axis of a couple, Resultant of several coplanar forces: moment of a certain couple as an area – couples in a parallel plane – Resultant of a couple and a force, equation of the line of action of the resultant: Sum of the moments about an arbitrary point.

(Sections: 4.6, 4.7, 4.8)

Unit IV: Forces on a rigid body (continued…): (15 hours)

Equilibrium of a rigid body under three coplanar forces.

A specific reduction of forces: Problems involving frictional forces – simple problems.

(Sections: 4.9, 5.2 (omit 5.2.1))

Unit V: Centre of mass: (15 hours)

Finding mass Centre of triangular lamina, three uniform rods forming a triangle, thin wire in the form of a circular arc, lamina in the form of sector of a circle, lamina in the form of quadrant of an ellipse, lamina in the form of a cardioid, solid hemisphere, solid right circular cone, hemispherical shell, hollow right circular cone.

(Sections: 6.1, 6.2.1, 6.2.2)

Text Book:

1. Duraipandian P, Laxmi Duraipandian and Muthamizh Jayapragasam, (2007), "Mechanics", 6th revised edition, S.Chand &Co., New Delhi.

Books for reference:

1. Narayanan S and others, "Statics", S. Chand & Co., New Delhi.
2. Venkataraman M. K., (2002), "A text book of Statics", Agastiar Publications, Trichy.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Recall the basic concept of forces and understand the Equilibrium of a particle.	**K1, K2, K3**
CO2	Analyze the concept of Moments and parallel forces.	**K1, K2, K4**
CO3	Illustrate couples and find the equation of the line of action of the resultant.	**K1, K2**
CO4	Understand the laws of frictions and solve related problems.	**K1, K2, K3**
CO5	Define Centre of mass and finding centre of gravity by using integration.	**K1, K2**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	2	1
CO2	3	3	3	3	2	1
CO3	3	3	3	3	2	1
CO4	3	3	3	3	2	1
CO5	3	3	3	3	2	1
Total	15	15	15	15	10	5
Average	3	3	3	3	2	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER - V

B.Sc. Degree Programme in Mathematics

Fifth Semester				
Course Title		**ABSTRACT ALGEBRA**		
Course Code		**22UEMAC1**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC IX	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To know the basic concept of groups and subgroups.
- To acquire knowledge of Normal subgroups and Quotient groups..
- To make students familiar with Automorphisms and Permutation groups.
- To define and explain rings, ideals and quotient rings.
- To know the concept of field of quotients of an integral domain and Euclidean rings.

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

Subgroups with examples - A counting principle.

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

Normal Subgroups and Quotient groups – Homomorphisms.

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

Automorphisms - Cayley's Theorem- Permutation Groups.

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

Rings – Definition and examples –Some special classes of Rings – Homomorphisms – Ideals and Quotient Rings.

Unit V:Ring Theory (Continued…): **(18 hours)**

More ideals and Quotient Rings – The Field of Quotients of an Integral Domain – Euclidean Rings.

Contents and Treatment as in :

1. Topics in Algebra by I.N.Herstein-2nd edition- John Wiley & sons
   Unit I: Chapter 2: Sections 2.4 & 2.5
   Unit II: Chapter 2: Sections 2.6 to 2.7.
   Unit III: Chapter 2: Sections 2.8 to 2.10.
   Unit IV: Chapter 3: Sections 3.1 to 3.4.
   Unit V: Chapter 3: Sections 3.5 to 3.7.

Reference Books:

1. Algebra – Arumugam S –New Gamma Publishing House, Palayamkottai.
2. A Text Book of Modern Algebra – Dr. M.L. Santiago - Tata McGraw Hill.

Web Resources:

1. http://mathworld.wolfram.com
2. https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Understand and appreciate the structure of groups and subgroups.	**K1, K2, K3, K4, K5**
CO2	Understand the concept of homomorphism and isomorphism of groups.	**K1, K2, K3, K4, K5**
CO3	Demonstrate the abstract thinking and ability to prove Cayley's theorem.	**K1, K2, K3, K4, K5**
CO4	Gain knowledge about the concepts of rings and quotient rings.	**K1, K2, K3, K4, K5**
CO5	Analyse the concept of the Field of Quotients of an Integral Domain and Euclidean Rings	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	1	1
CO2	3	2	2	3	1	1
CO3	3	3	2	3	1	1
CO4	3	3	2	3	1	1
CO5	3	3	2	3	1	1
Total	15	13	10	15	5	5
Average	3	2.6	2	3	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Fifth Semester				
Course Title		**Real Analysis – I**		
Course Code		**22UEMAC2**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC X	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To learn the concepts of real valued functions.
- To basic concepts of sequences and series of real numbers with their properties.
- To basic concepts of metric spaces.

UNIT I: Functions: **(18 hours)**

Real valued functions – Equivalence –Countability – Real numbers – Least upper bounds. (Sections 1.3 to 1.7)

Sequences of Real Numbers: Sequence of real numbers- Definition of sequence and subsequence – Limit of a sequence – Convergent sequences – Divergent Sequences. (Sections 2.1 to 2.4)

UNIT II: Sequences of Real Numbers (Continued…): **(18 hours)**

Bounded sequences – monotone sequences – operations on convergent sequences – operations on divergent sequences – Limit superior and limit inferior– Cauchy sequences. (Sections 2.5 to 2.10)

UNIT III: Series of real numbers: **(22 hours)**

Series of real numbers –Convergence and divergence– series with non-negative terms– alternating series– conditional convergence and absolute convergence– test for absolute convergence–Series whose terms form a non- increasing sequence.
(Sections 3.1 to 3.4, 3.6, 3.7)

UNIT IV: Limits and Metric Spaces: **(14 hours)**

limit of a function on the real line – metric spaces - limits in metric spaces.
(Sections 4.1 to 4.3)

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

Functions continuous at a point on the real line – reformulation–functions continuous on a Metric Space–open sets–closed set.
(Sections 5.1 to 5.5)

Text Book:

Richard R. Gold Berg, "Methods of Real Analysis", John Wiley and sons.

Reference Books:

1. Walter Rudin, "Principles of Mathematical Analysis", Mc-Graw Hill Book Co.
2. Tom.M. Apostol, "Mathematical Analysis", Narosa Publishing House.
3. Ajit Kumar, S. Kumaresan, "A basic course in Real Analysis", CRC Press, USA

Web Resources

1. https://nptel.ac.in/courses/111106053
2. https://mathcs.org/analysis/reals/numseq/sequence.html
3. https://mathcs.org/analysis/reals/numseq/subseq.html
4. https://mathcs.org/analysis/reals/numser/series.html
5. https://www.cambridge.org/core/books/abs/first-course-in-metric-spaces/basic-concepts-in-metric-spaces/70F521CDB66C8F1B7E72F779E62ABBD5

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignments, Field-based learning.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Demonstrate the basic knowledge of the real numbers that causes the formal development of Real analysis.	K2, K3
CO2	Define sequences and series of real numbers, interpret and apply the acquired knowledge to determine whether the given sequence and series are convergent/divergent.	K1, K2, K3, K5
CO3	Explain the basic ideas of limits and apply the concepts of limits to the theory of sequences and series.	K1, K2, K3
CO4	Explain and analyze the concepts of metric space; and define Continuity functions of metric spaces.	K1, K2, K3
CO5	Know how to make to use of the mathematical ideas to prove the basic results.	K1, K3, K5
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	1	1
CO2	3	2	2	3	1	1
CO3	3	3	2	3	1	1
CO4	3	3	2	3	1	1
CO5	3	3	2	3	1	1
Total	15	13	10	15	5	5
Average	3	2.6	2	3	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One questions from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Fifth Semester				
Course Title		**Mechanics – II**		
Course Code		**22UEMAC3**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC XI	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To understand the basic concepts of velocity, acceleration, etc.
- To define simple harmonic motion, relate it to simple pendulum and solve simple problems.
- To describe the motion of a projectile and its attributes. Able to solve problems on projectile motion.
- To interpret the laws of impact, analyze motions after impact and solve related problems.
- To explain the concept of moment of inertia and find M.I. of some simple bodies.

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

Velocity, resultant of velocities, relative velocity, acceleration, velocity and acceleration in a rectilinear motion, coplanar motion, angular velocity, relative angular velocity, rectilinear motion when the acceleration is constant.

Unit II: Simple harmonic motion: **(18 hours)**

Geometrical representation – composition of two simple harmonic motions – (Particle suspended in a spring not included)– Simple pendulum–simple problems.

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

Equation of path – time of flight – greatest height– horizontal range – Range on an inclined plane – simple problems.

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

Direct and oblique impacts – Impact on a smooth fixed plane – simple problems.

Unit V: **Moment of Inertia**: **(18 hours)**

Theorem of perpendicular axes and parallel axes, moment of inertia of uniform bodies: thin rod, rectangular lamina, circular ring, circular disc, elliptic lamina, solid sphere, hollow sphere, solid cone and hollow cone.

Text Book:

1. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam**, "M**echanics", S. Chand & Co., New Delhi.

Reference Books:

1. Mechanics – S.G. Venkatachalapathy –Margam Publishers
2. Dynamics – M.K. Venkataraman, National Publishing Co.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Seminars.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Demonstrate the understanding of basic concepts of velocity, acceleration etc., could relate them in linear motion with constant acceleration, analyze the motion and solve problems in some simple situations.	K1,K2,K3,K4
CO2	Define and analyze simple harmonic motion, summarize equation of motion & some important formulae, relate it to simple pendulum and solve simple problems.	K1,K2,K3,K4
CO3	Explain and analyze the motion of a projectile and its attributes. Able to apply the knowledge to solve problems on projectile motion.	K2,K3,K4, K5
CO4	Outline the laws of impact, analyze motions after impact and solve related problems.	K2,K3,K4
CO5	Explain the concept of moment of inertia, interpret parallel & perpendicular axis theorems and evaluate M.I of some simple bodies.	K2,K3,K4, K5
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	1	1
CO2	3	1	2	2	1	1
CO3	3	1	2	2	1	1
CO4	3	1	1	2	1	1
CO5	3	1	1	2	1	1
Total	15	6	8	10	5	5
Average	3	1.2	1.6	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Fifth Semester				
Course Title		**22UEMAC4**		
Course Code		**OPERATIONS RESEARCH**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Int+Ext)
CC XII	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To introduce operations research and its mathematical modellings.
- To formulate a linear programming problem and solve it by various algorithms
- To understand the basic principles of game theory and to find solutions to two-person zero-sum games.
- To find the optimal solution to transportation problem.
- To apply Hungarian method to find the optimal solution to an assignment problem.

Unit I: Linear Programming Problem: (18 hours)

Introduction to Operations Research – Linear Programming – formulation – graphical solution – Simplex Method.

Unit II: Linear Programming Problem (Continued…): (18 hours)

Big M – Method – Duality – Primal and Dual problems – Dual Simplex Method.

Unit III: Transportation Problem: (18 hours)

Transportation problem – Northwest corner rule –Least cost method – Vogel's Approximation method – MODI method – stepping stone method - Degeneracy – unbalanced transportation problem.

Unit IV: Assignment Problem: (18 hours)

Assignment problem – Hungarian Method – Unbalanced assignment problem – Travelling salesman problem.

Unit V: Game Theory: (18 hours)

Game Theory – Two people zero – sum game with saddle point and without saddle point – dominance property – solving 2 x n and m x 2 game by graphical method.

Text Book:

1. Kanti Swarup, P.K. Gupta and Manmohan, "Operations Research", Sultan Chand & Sons, New Delhi.

Reference Books:

1. Gupta.P.K.and D.S. Hira – Operations Research - S.Chand and Company, New Delhi.
2. V.Sundaresan, K.S. Ganapathy Subramanian and K.Ganesan, "Resource Management Techniques", A.R.Publications, Chennai.
3. Taha H., "Operations Research", Prentice Hall of India, New Delhi.
4. S. J. Venkatesan, "Operations Research", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. https://nptel.ac.in/
2. https://www.wolframalpha.com/widgets/view.jsp?id=daa12bbf5e4daec7b363737d6d496120
3. https://www.mathauditor.com/linear-programming-calculator.html
4. https://youtu.be/CirvnAH8A8M
5. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Flipped classroom.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Formulate a real-life problem into a linear programming problem and find its optimal solution by graphical method and by applying simplex algorithm.	**K1, K2, K3, K5**
CO2	Apply Big-M method and Dual simplex algorithm to solve an LPP and to analyze and solve an LPP using duality concepts.	**K1, K3, K4, K5**
CO3	Derive optimal strategies in a competitive environment (two players situation) using the methodologies of game theory.	**K1, K2, K3, K4, K5**
CO4	Select an appropriate method to find the IBFS and checking for optimality of a transportation problem and find its optimal solution.	**K1, K2, K3, K4, K5**
CO5	Apply Hungarian algorithm to identify an optimal solution for an assignment problem.	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	2	2
CO2	3	2	2	3	1	1
CO3	3	3	1	3	2	3
CO4	3	2	2	2	1	1
CO5	3	2	2	2	1	1
Total	15	12	9	13	7	8
Average	3	2.4	1.8	2.6	1.4	1.6

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Fifth Semester				
Course Title		**NUMERICAL METHODS**		
Course Code		**22UEMAE1A**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CEC I	**Elective**	**5**	**6**	**25 + 75=100**

Course objectives:

- To provide various mathematical tools to solve different kinds of numerical problems and to understand the importance of numerical methods.
- To solve algebraic, transcendental equations and simultaneous linear systems using various numerical methods
- To understand interpolation and use the concepts for mathematical problems arising in various fields.
- To understand numerical differentiation and integration.

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

The bisection method – iteration method – Newton's method – Regula-falsi method

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

Gauss elimination method – Gauss Jordon method - Gauss Jacobi method – Gauss Seidal method.

Unit III: Interpolation with equal intervals: (18 hours)

Operators $\Delta, \nabla$and E**,** Newton's forward - backward interpolation formula - Gauss forward - backward interpolation formula - Bessel's formula (No derivations for interpolation formulae)-simple problems.

Unit IV: Interpolation with unequal intervals: (18 hours)

Divided differences - Newton's divided difference formula - Lagrange's interpolation formula (No derivations for interpolation formulae)– Inverse Interpolation.

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

Newton's forward and backward differences to compute derivatives - Derivatives using Bessel's formula - Trapezoidal rule - Simpson's 1/3 and 3/8 th rule (No derivations)-simple problems.

Reference Books:

1. Venkataraman, M.K - Numerical Methods in Science and Engineering - National Publishing company, V Edition 1999.
2. Kandasamy, P. K. Thilagavathy, and K. Gunavathy - "Numerical Methods", S. Chand& Company Ltd., Edn. 2006.
3. Arumugam S., Isaac A. and Somasundaram, "Numerical analysis with Programming in C", New Gamma Publishing House, Palayamkottai, 2015.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Find the roots of algebraic and transcendental equations using various methods.	K1, K3,K5
CO2	Develop the knowledge of direct and indirect methods of solving simultaneous linear equations.	K1, K3
CO3	Explain the concept of interpolation (forward, backward, central) and apply them in suitable situations.	K1,K3,K5
CO4	Evaluate the value of a function when the arguments are not equally spaced.	K1,K3,K5
CO5	Summarize the rules of numerical integration (Trapezoidal, Simpson's) and apply them to evaluate definite integrals.	K1,K2,K5
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Fifth Semester				
Course Title		**DISCRETE MATHEMATICS**		
Course Code		**22UEMAE1B**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CEC I	**Elective**	**5**	**6**	**25 + 75=100**

Course objectives:

- To understand the basic concepts in mathematical logic.
- To understand the basic concepts of inference theory and predicate calculus.
- To learn the basic concepts of set theory and relations.
- To have an indepth knowledge of functions and recursion.

Unit I: Mathematical Logic: **(18 hours)**

Introduction – Statements and notation – Connectives.
(Chapter 1: 1.1 and 1.2)

Unit II: Mathematical Logic (continued…): **(18 hours)**

Normal forms – The theory of inference for the statement calculus.
(Chapter 1: 1.3 and 1.4)

Unit III: Mathematical Logic (continued…): **(18 hours)**

The predicate calculus – Inference Theory of the Predicate Calculus.
(Chapter 1: 1.5 and 1.6)

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

Introduction – Basic Concepts of Set Theory – Relations and Ordering.
(Chapter 2: 2.1 and 2.3)

Unit IV: Set Theory (Continued…): **(18 hours)**

Functions – Recursion.
(Chapter 2: 2.4 and 2.6)

Text Book:

- J. P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw – Hill, New Delhi, 2008.

Reference Books:

1. S.Wiitala, *Discrete Mathematics- A Unified Approach*, McGraw Hill Book Co.
2. A.Gill, *Applied Algebra for Computer Science*, Prentice Hall Inc., New Jersey.
3. J.L.Gersting, *Mathematical Structures for Computer Science*(3rd Edn.), Computer Science Press, New York.
4. Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, Spinger-Verlag, New York, 1984.

Web Resources:

- https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Understand connectives.	**K1, K2, K3, K4**
CO2	Write normal forms and understand the theory of inference for the statement calculus.	**K1, K2, K3, K4**
CO3	Demonstrate the understanding of predicate calculus.	**K1, K2, K3, K4**
CO4	Elaborate on Sets and relations.	**K1, K2, K3, K4**
CO5	Explain functions and recursions.	**K1, K2, K3, K4**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	1	2
CO2	3	3	3	3	1	2
CO3	3	3	3	3	1	2
CO4	3	3	3	3	1	2
CO5	3	3	3	3	1	2
Total	15	15	15	15	5	10
Average	3	3	3	3	1	2

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER - VI

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**LINEAR ALGEBRA**		
Course Code		**22UFMAC1**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC XIII	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To understand the basic of vector spaces and learn about Linear dependence.
- To introduce dual space and inner product spaces.
- To acquire the knowledge of Linear Transformation and Invertible.
- To visualize the linear transformation in matrix form.
- To convert the given matrices into canonical forms and triangular forms.

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

Elementary basic concepts- Linear dependence and bases

Unit II: Vector Spaces (continued…): **(18 hours)**

Dual spaces- Inner Product Spaces.

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

The Algebra of Linear transformations.

Unit IV: Linear Transformations (continued…): **(18 hours)**

Characteristic roots-Matrices.

Unit V: Linear Transformations (continued…): **(18 hours)**

Canonical Forms – Triangular form.

Contents and Treatment as in:

1. Topics in Algebra – I.N. Herstein – Wiley Eastern Ltd.

Chapter 4: sections 4.1 to 4.4, Chapter 6 : Sections 6.1 to 6.4.

Reference Books:

1. A Text Book of Modern Algebra – M.L. Santiago, Tata McGraw-Hill.
2. Algebra – S.Arumugam, New Gamma Publishing House, Palayamkottai.

Web Resources:

3. http://mathworld.wolfram.com
4. https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Explain the basic concept of vector spaces and bases.	**K1, K2, K3, K4**
CO2	Construct the orthonormal basis using Gram-Schmidt orthogonalization process.	**K1, K2, K3, K5**
CO3	Solve the system of linear equations.	**K1, K2, K3, K4, K5**
CO4	Represent a linear transformation in the form of a matrix.	**K1, K2, K3**
CO5	Find the canonical forms and triangular forms for a given square matrix.	**K1, K2, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	2	1
CO2	3	3	3	3	2	1
CO3	3	3	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	2	2	2
Total	15	15	15	14	10	8
Average	3	3	3	2.8	2	1.6

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**REAL ANALYSIS- II**		
Course Code		**22UFMAC2**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC XIV	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To learn the ideas of Open sets and Closed sets.
- To learn the basic concepts of Partition of an interval.
- To learn the basic concepts of pointwise convergence and uniform convergence.

UNIT I: Connected, Completeness and Compactness: (18 hours)

More about open Sets-Connected Sets-Bounded sets andtotally bounded sets.
(Sections 6.1 to 6.3)

UNIT II: Connected, Completeness and Compactness (Continued…): (18 hours)

Complete metric spaces-compact metric spaces continuous functions on compact metric spaces-continuityof inverse function- uniform continuity.
(Sections 6.4 to 6.8)

UNIT III: Calculus: (18 hours)

Sets of measure zero - definition of the Riemann Integral - existence of Riemann Integral (statement only) - properties of Riemann Integral.
(Sections 7.1 to 7.4)

UNIT IV: Calculus (Continued…): (18 hours)

Derivatives - Rolle's Theorem, Law of Mean-Fundamental Theorems of Calculus-Taylor's Theorem.
(Sections 7.5 to 7.8, 8.5)

UNIT V: Sequence and series of functions: (18 hours)

Pointwise convergence - uniform convergence of sequence of functions.
(Sections 9.1, 9.2)

Text Book:

Richard R. Gold Berg, "Methods of Real Analysis", John Wiley and sons.

Reference Books:

1. Walter Rudin, "Principles of Mathematical Analysis", Mc-Graw Hill Book Co.
2. Tom.M. Apostol, "Mathematical Analysis", Narosa Publishing House.
3. R. G. Bartle and D. R. Sherbert, "Introduction to Real Analysis", 4th Edition, John Wiley (Indian Edition)

Web Resources :

1. https://mathcs.org/analysis/reals/topo/open.html
2. https://mathcs.org/analysis/reals/topo/compact.html
3. https://mathcs.org/analysis/reals/topo/connect.html
4. https://mathcs.org/analysis/reals/integ/riemann.html

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignments, Field-based learning.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Demonstrate the basic knowledge of open sets and closed sets that causes the formal development of Real analysis.	K2, K3
CO2	Define Compactness, Completeness and Connectedness; interpret and apply the acquired knowledge to determine continuous functions on compact metric space; understand the concept of uniform continuity and continuity of inverse function.	K1, K2, K3, K5
CO3	Explain and analyze the concepts of partition of an interval.	K2, K4
CO4	Know how to apply and analyze the ideas of Rolle's theorem and mean value theorem and solve the problems.	K1, K3, K4
CO5	Know how to make use of explain the concept of Pointwise convergent and uniform convergent; Also analyze the given series is pointwise convergent, uniformly convergent.	K1, K2, K4
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	3	1	1
CO2	2	2	2	2	1	1
CO3	3	2	2	3	1	1
CO4	3	3	2	3	1	1
CO5	3	3	2	3	1	1
Total	14	12	9	14	5	5
Average	2.8	2.4	1.8	2.8	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**COMPLEX ANALYSIS**		
Course Code		**22UFMAC3**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CC XV	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

- To learn necessary and sufficient conditions for analyticity and define harmonic functions.
- To understand Cauchy's theorem and Cauchy's integral formula and related theorems and apply them to solve certain integrals.
- To expand given complex function using Taylor's series and Laurent's series.
- To understand residues and residue theorem and use them to evaluate some definite integrals and improper integrals.
- To understand some basic and standard transformations.

Unit I: Functions of a complex variable: **(18 hours)**

Theorems on Limits – Derivatives – C-R equations – Sufficient conditions – Analytic functions – Harmonic functions.

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

Riemann's definition of contour integrals – Cauchy's theorem (Proof using Green's theorem only) – Cauchy's integral formula – Formula for higher derivatives –Morera's theorem- Cauchy's inequality – Liouville's theorem – Fundamental theorem of Algebra.

Unit III: Power Series: **(18 hours)**

Taylor's series – Laurent's series – Zeros of an analytic function – Types of singularities.

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

Cauchy's Residue theorem – Evaluation of integrals around a unit circle – Evaluation of improper real integrals with poles not on the real axis.

Unit V: Transformations: **(18 hours)**

Conformal mappings - basic properties – Mappings $w = 1/z$, $w = z^2$, $w = e^z$ - Bilinear Maps- Fixed points.

Content and Treatment as in :

1. R.V. Churchill and J.W. Brown, "Complex Variables and Applications", 5th Edition, McGraw – Hill International Book co.

   For unit I: Sec 9,10,11,14,15,17,18,19,20,21
   For unit II: Sec 65,66,68.
   For unit III. Sec 31, 32, 35, 39, 40, 43
   For unit IV: Sec 45, 47
   For unit V: Sec 53, 54, 55, 56, 58, 59, 60.

Reference Books:

1. Complex Analysis – Duraipandian, Emerald Publishers.
2. Complex Analysis – Narayanan and T.K. Manicavachogam Pillai (Viswanathan S publishers).
3. S. J. Venkatesan, "Complex Analysis", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. http://ebooks.lpude.in.complexanalysis/
2. https://nptel.ac.in/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Test the analyticity of functions of complex variable.	**K1, K2, K3**
CO2	Find the integrals of complex functions using Cauchy's integral formula and explain them such as Cauchy's inequality, Liouville's theorem, fundamental theorem of algebra.	**K1, K2, K3**
CO3	Find power series expansion of complex functions and the region of validity.	**K1, K2, K3**
CO4	Evaluate definite integrals and improper real integrals in light of Cauchy's residue theorem.	**K1, K2, K3, K4**
CO5	Elaborate on conformal mapping and learn bilinear transformations and some standard transformations.	**K1, K2, K3, K4**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**GRAPH THEORY**		
Course Code		**22UFMAE2A**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CEC II	**Elective**	**5**	**6**	**25 + 75=100**

Course objectives:

- To provide a basic foundation of Graph Theory with applications to a wide variety of subjects.
- To understand the types of graphs and the connectivity of graphs.
- To familiarize Eulerian and Hamiltonian graphs.
- To understand the characteristics of trees, planar graphs and digraphs.

Unit I: Introduction to graphs & subgraphs: **(18 hours)**

Definition and examples. Degrees, subgraphs, isomorphism, independent sets and coverings, intersection graphs and line graphs, matrices.
(Chapter2: sec 2.1 to 2.8 omit 2.5)

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

Degree sequences, graphic sequences – simple problems. Connectedness: Walks, trails and paths, connectedness and components. Blocks, connectivity.
(Chapters: 3 and 4)

Unit III: Eulerian and Hamiltonian graphs: **(18 hours)**

Eulerian and Hamiltonian Graphs, simple problems.
(Chapter 5)

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

Introduction, characterization of trees, Centre of a trees.
(Chapters 6)

Unit V: **Planarity and Digraphs**: **(18 hours)**

Introduction, definition and properties. Directed graphs: introduction, definition and basic properties – paths and connections – digraphs and matrices.
(Chapter 8 &10 omit 8.2, 8.3, 10.4)

Contents and Treatment as in :

1. "Invitation to graph theory "- S. Arumugam & S. Ramachandran

Reference Books:

1. A First Look at Graph Theory – John Clark – Allied Publishers.
2. Graph Theory – S. Kumaravelu and Susheela Kumaravelu.
3. A First Course in Graph Theory –S.A. Choudam – Macmillan India Ltd.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Explain the fundamental concepts of Graph Theory. Further, identify and construct examples to represent graphs in matrix form.	K1, K2,K3
CO2	Define graphical partitions and construct graphs realizing the partitions. Also, elaborate the connectedness of graphs.	K1, K3
CO3	Understand and explain Eulerian and Hamiltonian graphs, apply these concepts in some real-life situations.	K2,K3
CO4	List out the properties of trees and prove related theorems.	K1,K2,K5
CO5	Illustrate the concept of planarity and digraphs; use Graph Theory as a modeling tool.	K2,K3,K4
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**ELEMENTARY NUMBER THEORY**		
Course Code		**22UFMAE2B**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CEC II	**Elective**	**5**	**6**	**25 + 75=100**

Course objectives:

- To understand the history of theory of numbers, and the richness of the subject.
- To Acquire skill to solve real life problems by solving system of congruences.
- To Understand the quadratic residues.
- To Appreciate the solutions of Diophantine and Pythagorean triangles.

Unit I: Divisibility & Congruences: **(18 hours)**

Divisibility, Congruences, Solution of Congruences.

Unit II: Congruences (Continued…): **(18 hours)**

Chinese Remainder Theorem, Number Theory from an Algebraic view point, Groups, Rings and Fields.

Unit III: Quadratic Residues: **(18 hours)**

Quadratic Residues, Quadratic reciprocity, The Jacobi Symbol .

Unit IV: Greatest Integer function: **(18 hours)**

Greatest integer function, Arithmetic Functions. TheMobius Inversion formula.

Unit V: Some Diophantine Equations: **(18 hours)**

The equation ax+by=c, Simultaneous Linear Equations, Pythagorean Triplets, Assorted Examples (simple problems only).

Reference Books:

1. An Introduction to the Theory of Numbers (V Edition) by Ivan Niven, Herbert S.Zuckarman and Hugh L.Montgometry-John Wiley and Sons.
2. David N. Burton, "Elementary Number Theory", 6th Edition, Tata McGraw Hill Publishers, 2008.
3. Kumaravelu. S and SusheelaKumaravelu – Elements of Number Theory, Nagercoil, 2002.
4. Neville Robbins, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd.,Delhi, 2007.

Web Resources:

- http://mathworld.wolfram.com
- https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Seminars.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	explain the concept of division algorithm and solve simple problems.	**K1, K2, K3, K4**
CO2	demonstrate the features of congruences and able to explain Chinese remainder theorem.	**K1, K2, K3, K4**
CO3	Demonstrate the understanding of quadratic residues	**K1, K2, K3, K4**
CO4	compute the greatest integer function and explain the mobius inversion formula	**K1, K2, K3, K4**
CO5	evaluate the Diophantine equations	**K1, K2, K3, K4**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	1	1	1
CO2	3	2	2	1	1	1
CO3	3	2	2	1	1	1
CO4	3	2	2	1	1	1
CO5	3	2	2	1	1	1
Total	15	11	10	5	5	5
Average	3	2.2	2	1	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**RESOURCE MANAGEMENT TECHNIQUES**		
Course Code		**22UFMAE3A**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CEC III	**Elective**	**5**	**6**	**25 + 75=100**

Course objectives:

- To understand project management and apply CPM and PERT methods to find the minimum project completion time.
- To identify a suitable inventory model for the real time case studies.
- To find the economic order quantity of various inventory models.
- To learn how to minimize the average queue length and the average waiting time of the customers in a queueing system.
- To acquire knowledge in finding the minimum total elapsed time in a sequencing problem.

Unit I: **Project Management:** **(18 hours)**

PERT and CPM – Project network diagram – criticalpath (crashing excluded) – PERT computations.

Unit II:**Inventory Models:** **(18 hours)**

Inventory models – basic concepts – EOQ Models –Uniform demand rate, infinite production rate with andwithout shortages. Uniform demand rate, finiteproduction rate with and without shortages.

Unit III: **Inventory Models (continued…):** **(18 hours)**

Deterministic models with Price Breaks – Purchaseinventory model: with one price break, with two pricebreaks and with any number of price breaks – classicalnewspaper – boy problem with discrete demand.

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

Queuing Theory – basic concepts – steady stateanalysis of M/M/1 and M/M/C – systems with infiniteand finite capacities.

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

Sequencing Problems – n jobs through 2 machines – njobs through 3 machines – two jobs through m machines- n jobs through m machines.

Text Book:

Kanti Swarup, P.K. Gupta and Manmohan, "Operations Research", Sultan Chand & Sons, New Delhi.

Reference Books:

1. Gupta.P.K.and D.S. Hira – Operations Research - S. Chand and Company, New Delhi.
2. V.Sundaresan, K.S. Ganapathy Subramanian and K.Ganesan, "Resource Management Techniques",A.R.Publications, Chennai.
3. Taha H."Operations Research", Prentice Hall of India, New Delhi.
4. S. J. Venkatesan, "Operations Research", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Flipped classroom.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Draw networks and find the critical path in a network problem and also able to analyze the available floats.	**K1, K2, K3, K4**
CO2	Find the economic order quantities for some deterministic inventory models with and without shortages.	**K1, K2, K3, K4, K5**
CO3	Find the economic order quantity for some deterministic inventory models with price breaks and also able to find optimum order size for a probabilistic inventory model with discrete demand.	**K1, K2, K3, K4, K5**
CO4	Minimize the average queue length and average waiting time of the customers in finite and infinite capacity queueing systems with single server and multi-server models.	**K1, K2, K3, K4, K5**
CO5	Find the optimal sequence of jobs so as to minimum total elapsed time and idle times of the machines in a sequencing problem.	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	1
CO2	3	3	3	3	1	2
CO3	3	3	3	3	1	2
CO4	3	3	3	3	1	2
CO5	3	3	3	2	1	2
Total	15	14	15	13	6	9
Average	3	2.8	3	2.6	1.2	1.8

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme in Mathematics

Sixth Semester				
Course Title		**PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS**		
CourseCode		**22UFMAE3B**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
CEC III	**Elective**	**5**	**6**	**25 + 75=100**

Course objectives:

- To solve PDEs by separation of variables.
- To understand and solve problems on wave equations.
- To understand and solve problems on one dimensional heat equations.
- To understand and solve problems on Laplace equations.
- To summarize solution of Laplace equations in polar coordinates and applied for temperature distribution.

Unit I: Introduction to PDE: **(18 hours)**

Basic concepts-Partial differential equations, Fourier series, solving PDE-using separation of variables simple problems.

Unit II: Wave Equation: **(18 hours)**

Partial differential equations – definition and examples, Transverse vibration of a string – solution of wave equation by separation of variables – displacement expressed in Fourier series.

Unit III: One dimensional Heat equation: **(18 hours)**

One dimensional heat flow – Heat equation and its solution. Two-dimensional heat flow (steady state only).

Unit IV: Laplace equation: **(18 hours)**

Laplace equation in two dimensions and its solutions, temperature distribution in rectangular plates.

Unit V: Laplace equation in polar coordinates: **(18 hours)**

Laplace's equation in polar coordinates and its solution. Temperature distribution in circular annulus.

Reference Books:

1. Advanced Calculus for Applications – F.B. Hilder Brandt.
2. Differential Equations – Diwan and Agshe.
3. Mathematics for Engineers and Physicists – Louis R Pes.

Web Resources:

1. https://nptel.ac.in/
2. https://mathworld.wolfram.com/

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Seminars.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Recall preliminaries of PDE and Fourier series, understand the method of separation of variables and solve simple problems.	**K1, K2, K3, K4**
CO2	Understand and analyze wave equations and solve problems.	**K1, K2, K3, K4, K5**
CO3	Understand and analyze one dimensional heat equations and solve problems.	**K1, K2, K3, K4, K5**
CO4	Understand and analyze two-dimensional heat equations and solve problems.	**K1, K2, K3, K4, K5**
CO5	Understand and analyze two-dimensional heat equations in polar coordinates and solve problems.	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	2	1	1
CO2	3	3	3	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
	15	15	12	10	5	5
Average	3	3	2.4	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

ALLIED COURSES

B.Sc. Degree Programme (for Computer Science, Chemistry and Physics)

First Semester				
Course Title		**ALLIED MATHEMATICS-I**		
Course Code		**22UAMAA1**		
Course No.	Course Category Core / Elective	No. of Credits	No. of hrs /week	Total marks (Internal+External)
AC I	**Allied**	**5**	**7**	**25 + 75=100**

Course objectives:

- To define and explain Hermitian, Skew Hermitian, Orthogonal and Unitary Matrices.
- To acquire knowledge of solving problem in Matrices.
- To develop the ability of different types of solving algebraic equations.
- To acquire knowledge about the expansions of $sinnx, cosnx, tannx$.
- To write the given function in terms of sine and cosine terms in Fourier series.

Unit I: **Matrices:** **(21 hours)**

Symmetric,Skew-symmetric, Hermitian, Skew Hermitian, Orthogonal and Unitary matrices.

Unit II: Matrices(continued): **(21 hours)**

Characteristic Equation–Eigen values and Eigen vectors–Cayley Hamilton Theorem (Statement only).

Unit III:Theory of equations: **(21 hours)**

Polynomial Equations–Imaginary and Irrational roots–Transformation of Equations–Reciprocal equations–simple problems.

Unit IV: **Trigonometry:** **(21 hours)**

Expansionof sinnx,cosnx,tannx,sin$^n x$,cos$^n x$, Expansion of sin$x$,cos$x$and tan$x$ in ascending powers of x.

Unit V: Fourier Series: **(21 hours)**

Definition- Fourier series expansion of periodic functions (0, 2π) and (-π, π).

Text Book:

P. R. Vittal, "Allied Mathematics", Margam Publications, Chennai.

Reference books:

1. P. Duraipandian and Dr. S. Udayabaskaran, "Allied Mathematics Vol I", Muhil Publishers, Chennai.
2. Dr. S.P. Rajagopalan and Dr. R. Sattanathan, "Allied Mathematics"
3. S. J. Venkatesan, "Allied Mathematics", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. http://mathworld.wolfram.com
2. https://nptel.ac.in

METHODOLOGY OF TEACHING:

Class lectures, Group Discussion, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Recall the basics of Matrices and learns Hermitian, Skew Hermitian, Orthogonal,Unitary Matrices and solve related problems.	**K1, K2, K3**
CO2	To familiarize about Eigen values and Eigen Vectors andapply Cayley-Hamilton theorem for finding inverse.	**K1, K2, K3, K5**
CO3	Analyze the method of solving reciprocal equations.	**K1, K2, K3.**
CO4	Recall the basic concepts and understand the expansions of Trigonometric functions.	**K1, K2, K3**
CO5	Understand and find Fourier series of a given periodic function.	**K1, K2, K3,K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	2	2	1
CO2	3	3	3	2	2	1
CO3	3	3	3	2	2	1
CO4	3	3	3	2	2	1
CO5	3	3	3	2	2	1
Total	15	15	15	10	10	5
Average	3	3	3	2	2	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. Degree Programme (for Computer Science, Chemistry and Physics)

Second Semester				
Course Title		**ALLIED MATHEMATICS-II**		
Course Code		**22UBMAA2**		
Course No.	Course Category Core / Elective	No. of Credits	No. of hrs /week	Total marks (Internal+External)
AC II	**Allied**	**5**	**7**	**25 + 75=100**

Course objectives:

- To acquire knowledge of n^{th} derivatives and Radius of Curvature.
- To learn solution methodologies of 2^{nd} order homogeneous and non-homogeneous ODE with constant coefficients.
- To obtain knowledge of Laplace transform and its application to solution of ODE.
- To define and explain Gradient, Divergence, Curl and their applications.
- To learn basics of vector integration and understands integral theorems.

Unit I: Differential Calculus: (21 hours)

n^{th} derivatives–Leibnitz theorem (without proof) and applications– Radius of Curvature in Cartesian coordinates.

Unit II: Differential Equations: (21 hours)

Second order differential equation with constantcoefficient - particular integral of the type e^{ax}, cosax, sinax, e^{ax} V, where V is any function of cosax or sinax or x or x^2.

Unit III: Laplace Transforms: (21 hours)

Laplace transformation of standard functions and simple properties, Inverse Laplace Transforms, application to solution of lineardifferential equations with constant coefficients.

Unit IV: Vector Calculus: (21 hours)

Vector Differentiation – Scalar Point functions, VectorPoint functions, Gradient, Divergence, Curl, Directional derivatives, normal to a surface.

Unit V: Vector Calculus (Continued…): (21 hours)

Vector integration - line, surface and volume integrals- Gauss, Stoke's and Green's theorems (statement only) – simple problems.

Text Book:

P. R. Vittal, "Allied Mathematics", Margam Publications, Chennai.

Reference books:

1. P. Duraipandian and Dr. S. Udayabaskaran, "Allied Mathematics Vol II", Muhil Publishers, Chennai.
2. Dr. S.P. Rajagopalan and Dr. R. Sattanathan, "Allied Mathematics"
3. S. J. Venkatesan, "Allied Mathematics", Sri Krishna Publications, Chennai – 77.

Web Resources:

1. http://mathworld.wolfram.com
2. https://nptel.ac.in

METHODOLOGY OF TEACHING:

Class lectures, Group Discussion, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Recall differentiation, understand the concepts of n^{th} derivatives, radius of curvature and solve related simple problems.	**K1, K2, K3**
CO2	Learn solution methods for second order differential equations with constant coefficients having RHS functions as e^{ax}, cosax, sinax, e^{ax} V and could evaluate simple problems.	**K1, K2, K3, K5**
CO3	Define Laplace Transforms, summarize its properties, find LT & Laplace inverse Laplace transform of certain simple functions and apply them to solve simple ODEs.	**K1, K2, K3.**
CO4	Recall basics of vector algebra and learns gradient, divergence, curl and their applications, and solve simple problems.	**K1, K2, K3**
CO5	Recalls Multiple integrals learns evaluating line, surface and volume integrals, relate them by understanding integral theorems(Gauss, Green's, Stoke's) and justify integral theorems through simple examples.	**K1, K2, K3,K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix):

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	2	2	1
CO2	3	3	3	2	2	1
CO3	3	3	3	2	2	1
CO4	3	3	3	2	2	1
CO5	3	3	3	2	2	1
Total	15	15	15	10	10	5
Average	3	3	3	2	2	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

NON-MAJOR ELECTIVES

First Semester				
Course Title		**ANALYTICAL SKILLS AND APTITUTE**		
Course Code		**22UAMAN1A**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
NME I	**Elective**	**2**	**2**	**25 + 75=100**

Course objectives:

- To recall the knowledge of arithmetical ability.
- To find simple interest and compound interest.
- To understand the permutations and combinations and utilize the probabilities.
- To choose odd man out and simplify the values of series.
- To develop the data interpretation.

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

Problems in numbers, fractions, roots.

Unit II: **Basic formulae and problems:** **(6 hours)**

On simple interest, compound interest.

Unit III: Permutations and combinations, probabilities: **(6 hours)**

Simple problems.

Unit IV: **Odd man out and series**:

Problems. **(6 hours)**

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

Bar Graphs, Pie Charts.

Reference Book:

Quantitative Aptitude for Competitive Examinations – R.S. Agarwal

Web Resources:

- http://mathworld.wolfram.com
- https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Make use of arithmetical problems in numbers, fractions and roots.	**K1, K2, K3**
CO2	Recall the formulae of Simple and Compound interest and find the solutions of Simple and Compound interest problems.	**K1, K2, K3**
CO3	Formulate the permutations and combinations and determine its solutions. Find also the probabilities and solve it.	**K1, K2, K3, K5**
CO4	Find an odd man out and estimate the values of series.	**K1, K2, K3**
CO5	Understand Bar Graphs and Pie Charts, find the solution to its interpretation.	**K1, K2, K3**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

First Semester				
Course Title		**DESCRIPTIVE STATISTICS**		
Course Code		**22UAMAN1B**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
NME I	**Elective**	**2**	**2**	**25 + 75=100**

Course objectives:

- To have an introduction to statistics and learn its importance.
- To represent data pictorially for further analysis.
- To understand the measures of averages and apply them in practical situations.
- To understand the measures of dispersion and use them to analyze data.

Unit I: Introduction: **(6 hours)**

Introduction to Statistics - classification and tabulation of data.

Unit II: Diagrammatic representation: **(6 hours)**

Diagrammaticrepresentationof data– bar, pie diagram, pictogram, graphical representation of data.

Unit III: Measures of central tendencies: **(6 hours)**

Measures of averages – mean, arithmetic mean, geometric mean, harmonic mean.

Unit IV: Measures of central tendencies (continued…): **(6 hours)**

Median, mode – problems on measures of averages.

Unit V: Measures of dispersion: **(6 hours)**

Measures of dispersion – range, quartile deviation, standard deviation, coefficient of variation.

Text Book:

Statistical Methods, S.P. Gupta, S. Chand and co.

Reference Book:

Business statistics, P.R. Vittal, Margam publishers.

Web Resources:

- http://mathworld.wolfram.com
- https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Seminars.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Classify, tabulate and interpret data.	**K1, K2, K3, K4, K5**
CO2	Represent data pictorially.	**K1, K2, K3, K4, K5**
CO3	Compute measures of averages arithmetic mean, geometric mean and harmonic mean.	**K1, K2, K3, K4, K5**
CO4	Compute median and mode.	**K1, K2, K3, K4, K5**
CO5	Compute the measures of dispersion such as standard deviation, quartile deviations, etc.	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	1	2
CO2	3	3	3	3	1	2
CO3	3	3	3	3	1	2
CO4	3	3	3	3	1	2
CO5	3	3	3	3	1	2
Total	15	15	15	15	5	10
Average	3	3	3	3	1	2

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

Second Semester				
Course Title		**FUNCTIONAL MATHEMATICS**		
Course Code		**22UBMAN2A**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
NME II	**Elective**	**2**	**2**	**25 + 75=100**

Course objectives:

- To recall the knowledge of logic and arithmetical ability.
- To find Profit and Loss, Ratio and Proportion.
- To understand the problems on Time and Work, Time and Distance.
- To demonstrate problems on Trains, problems on Races and Games of Skill.
- To solve the problems on stocks and shares.

Unit I:Logic and arithmetical ability: **(6 hours)**

Problems on ages, surds and indices.

Unit II:Basic formulae and problems: **(6 hours)**

On Profit and Loss, Ratio and Proportion.

Unit III: Basic formulae and problems: **(6 hours)**

On Time and Work, Time and Distance.

Unit IV: Basic formulae and problems: **(6 hours)**

On Trains, problems on Races and Games of Skill.

Unit V: Basic formulae and problems: **(6 hours)**

On stocks and shares.

Reference Book:

Quantitative Aptitude for Competitive Examinations – R.S. Agarwal

Web Resources:

5. http://mathworld.wolfram.com
6. https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Interpret to do arithmetical problems on ages, surds and indices.	**K1, K2, K3, K5**
CO2	Understand problems on Profit and Loss, Ratio and Proportion. Also, find its solution.	**K1, K2, K3**
CO3	Relate problems on Time and Work, Time and Distance. Also, estimate its solution.	**K1, K2, K3, K5**
CO4	Recall problems on Trains, problems on Races and Games of Skill, determine its solution.	**K1, K2, K3, K5**
CO5	Define stocks and shares, find solutions to problems on stocks and shares.	**K1, K2, K3**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	2	2	1	1
CO5	3	3	2	2	1	1
Total	15	15	10	10	5	5
Average	3	3	2	2	1	1

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**

Second Semester				
Course Title		**FUNCTIONAL STATISTICS**		
Course Code		**22UBMAN2B**		
Course No.	Course Category Core / Elective /	No. of Credits	No. of hours /week	Total marks (Internal+External)
NME II	**Elective**	**2**	**2**	**25 + 75=100**

Course objectives:

- To understand various measures of skewness and apply them in suitable situations.
- To have a glimpse of moments and kurtosis.
- To understand the concept of correlation and learn formulae for find it and apply them.
- To explain the concept of regression equations so as to establish a relationship between two variables.
- To fit curves for the given data.

Unit I: Skewness: **(6 hours)**

Karl Pearson's coefficient of skewness – Bowley's coefficient of skewness – simple problems.

Unit II: Moments: **(6 hours)**

Moments and Kurtosis – simple problems

Unit III: Correlation: **(6 hours)**

Correlation – Karl Pearson's coefficient of correlation – rank correlation – simple problems.

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

Regression – regression equations of X on Y and Yon X – simple problems.

Unit V: Curve fitting: **(6 hours)**

Curve fitting – linear and quadratic.

Text Book:

Statistical Methods, S. P. Gupta, S. Chand & Co.

Web Resources:

- http://mathworld.wolfram.com
- https://nptel.ac.in

METHODOLOGY OF TEACHING:

Classroom lectures, Tutorial class, Discussions, Assignments, Seminars.

Course Outcomes (COs):

Upon completion of this course, the students will be able to

CO code	Course Outcomes	K-levels
CO1	Find the coefficient skewness for the given data.	**K1, K2, K3, K4, K5**
CO2	Compute moments and kurtosis for the given data.	**K1, K2, K3, K4, K5**
CO3	Identify the degree of relationship from coefficient of correlation.	**K1, K2, K3, K4, K5**
CO4	Establish the relationship between two variables using regression analysis.	**K1, K2, K3, K4, K5**
CO5	Fit linear and quadratic curves for the given data.	**K1, K2, K3, K4, K5**
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating.		

CO- PO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	1	3
CO2	3	3	3	3	1	3
CO3	3	3	3	3	1	3
CO4	3	3	3	3	1	3
CO5	3	3	3	3	1	3
Total	15	15	15	15	5	15
Average	3	3	3	3	1	3

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1, K2, K3, K4	A (Answer all the questions)	10 x 2	Short Answer (Two questions from each unit)	20
K1, K2, K3, K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 x 5	Question (a) OR (b) from the same Unit and same K Level	25
K2, K3, K4, K5	C (Answer any three questions from five questions)	3 x 10	One question from each unit (No unit missing)	30
Grand Total				**75**