

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR**  
**DEPARTMENT OF MATHEMATICS**  
**B.Sc. MATHEMATICS**  
**CBCS - OBE PATTERN (From 2022 – 2023 onwards)**

<b>I SEMESTER</b>				
<b>PART</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hrs</b>	<b>Cr</b>
I	22UTAL11/ 22UHNL11/ 22UFNL11	Tamil / Hindi / French	06	04
II	22UENA11/ 22UENB11	English through Prose & Short Story – Stream A English through Prose & Short Story – Stream B	05	04
III	22UMAC11	Core – 1 Algebra and Trigonometry	06	05
	22UMAC21	Core – 2 Mathematical Statistics – I	06	05
	22UPYB11/ 22UCHB11	Allied – 1 Allied Physics / Chemistry	03	03
	22UPYR12/ 22UCHR12	Allied Physics / Chemistry Lab	02	
	22UMAB11	Allied – 1 Allied Mathematics – I (for Phy/Che)		
IV	22UFCE11	FC - Personality Development	01	01
V	22UCSH12	Communication Skills	01	-
	22UNCC/NSS/ PHY.EDU./ YRC/ ROT/ACF/NCB12	Extension Activities NSS / NCC / Phy.Edn / YRC / ROTARACT / AICUF / Nature Club	-	-
	22UBRC11	Bridge Course		01
		<b>TOTAL</b>	<b>30</b>	<b>23</b>
<b>II SEMESTER</b>				
I	22UTAL22/ 22UHNL22/ 22UFNL22	Tamil / Hindi / French	06	04
II	22UENA22 22UENB22	English through Prose & Poetry – Stream A English through Prose & Poetry – Stream B	05	04
III	22UMAC32	Core – 3 Calculus	06	05
	22UMAC42	Core – 4 Mathematical Statistics – II	06	05
	22UPYB22/ 22UCHB22	Allied – 2 Allied Physics / Chemistry	03	03
	22UPYR12/ 22UCHR12	Allied Physics / Chemistry Lab	02	02
	22UMAB22	Allied – 2 Allied Mathematics–II (for Phy & Che)		
IV	22UFCH22	FC - Social Analysis and Human Rights	01	01
	22UCSH12	Communication Skills	01	01
V	22UNCC/NSS/ PHY.EDU./ YRC/ ROT/ACF/	Extension Activities NSS / NCC / Phy.Edn. / YRC/ ROTARACT / AICUF / Nature Club		01
		<b>TOTAL</b>	<b>30</b>	<b>26</b>

III SEMESTER				
I	22UTAL33/ 22UHNL33/ 22UFNL33	Tamil / Hindi / French	06	04
II	22UENG33	English Through Literature I	06	04
III	22UMAC53	Core – 5 Sequences and Series	06	05
	22UMAA33	Allied – 3 Analytical Geometry of 3D & Vector Calculus	05	04
IV	22UMAN13	NME – 1 Mathematics for Competitive Examinations (for Arts)	03	02
	22USBE13	SBE – 1 Fundamentals of Computer, Internet and Office Automation	01	01
	22USBP13	SBE – 1 Fundamentals of Computer, Internet and Office Automation - Practical	02	01
	22UFCE33	FC – Environmental Studies	01	01
V	22UNCC/NSS/ PHY.EDU./ YRC/ ROT/ACF/NCB24	Extension Activities NSS / NCC / Phy.Edn. / YRC / ROTARACT / AICUF / Nature Club	...	
	22UARE14	ARISE	-	-
		<b>TOTAL</b>	<b>30</b>	<b>22</b>
IV SEMESTER				
I	22UTAL44/ 22UHNL44/ 22UFNL44	Tamil / Hindi / French	06	04
II	22UENG44	English Through Literature II	06	04
III	22UMAC64	Core – 6 Mechanics	06	05
	22UMAA44	Allied – 4 Differential Equations and Applications	05	04
IV	22UMAN24	NME – 2 Resource Optimization Techniques (for Science)	03	02
	22USBE24	SBE – 2 Programming in C	01	01
	22USBP24	SBE – 2 Programming in C Practical	02	01
	22UFCH44	FC – Bioethics, Religions and Peace Studies Catechism of the Catholic Church	01	01
V	22UNCC/NSS/ PHY.EDU./ YRC/ ROT/ACF/NCB24	Extension Activities NSS / NCC / Phy.Edn. / YRC / ROTARACT / AICUF/ Nature Club		01
	22UARE14	ARISE		01
		<b>TOTAL</b>	<b>30</b>	<b>24</b>

V SEMESTER				
III	22UMAC75	Core – 7 Modern Algebra	06	05
	22UMAC85	Core – 8 Real Analysis	06	05
	22UMAC95	Core – 9 Numerical Methods using C++	04	04
	22UMAP15	Core Lab Numerical Methods using C++ Lab	02	1
	22UMAD05	Core – 10 Operations Research	06	05
	22UMAЕ15	Core Elective -1 (A) Number Theory Core Elective -1 (B) Elements of Topology	04	03
IV	22UIN15	Internship	-	01
	22USSI16	Soft Skills – I	02	-
		<b>TOTAL</b>	<b>30</b>	<b>24</b>
VI SEMESTER				
III	22UMAD16	Core – 11 Linear Algebra	06	05
	22UMAD26	Core – 12 Complex Analysis	06	05
	22UMAD36	Core – 13 Graph Theory	06	05
	22UMAD46	Core – 14 Industrial Optimization Techniques	06	05
	22UMAЕ26	Core Elective – 2 (A) Java Programming Core Elective – 2 (B) R Programming	02	02
	22UMAJ16	Core Elective Lab Java Programming Lab / R Programming Lab	02	01
IV	22USSI16	Soft Skills – II	02	02
		<b>TOTAL</b>	<b>30</b>	<b>25</b>

Semester	I	II	III	IV	V	VI	Total
Credits	23	26	22	24	24	25	<b>144</b>

Part I **16 credits**

Part II **16 credits**

Part III

Core	70
Allied	16
Core Electives	06
<b>Total</b>	<b>92 credits</b>

Part IV

Non-Major Electives	04
Skill based Electives	04
Foundation Courses	04
<b>Total</b>	<b>12 credits</b>

Part V

Extension Activities	02
ARISE	01
Bridge Course	01

Soft Skills	02
Communicative Skills	01
Internship	01
<b>Total</b>	<b>08 credits</b>

Credits	Part I	Part II	Part III	Part IV	Part V	Total
	16	16	92	12	08	<b>144</b>

### Self-Learning Courses

Semester	Course Code	Course Title	Credits
III	22UMASL3	Solar System	03
IV	22UMASL4	Stellar Universe	03
V	22UMASL5	Statistical Methods in Social Sciences	03
VI	22UMASL6	Mathematical Methods in Business	03

### Value Added Courses (Certificate Course - 30 hours)

Data Analysis using R  
 Introduction to LaTeX  
 Data Analysis using Python  
 Introduction to Machine Learning

### Career Oriented Courses

Quantitative Reasoning  
 Mathematics for Competitive Examinations  
 Resource Management Techniques  
 Optimization Techniques in Production

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR**  
**DEPARTMENT OF MATHEMATICS**  
**Algebra and Trigonometry**

(For those who join from June 2022 onwards)

<b>Class</b>	<b>: B.Sc. Mathematics</b>	<b>Part</b>	<b>: III/Core-1</b>
<b>Semester</b>	<b>: I</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22UMAC11</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course will enable the students to gain profound knowledge on solving equations of higher order and apply different methods of finding the summation of trigonometric series.

**Course Content:**

- Unit 1:** Introduction to equations – Transformation of equations – standard forms to increase and decrease the roots of the equation by a given quantity – removal of terms **(18 hours)**
- Unit 2:** Multiple roots – working rule to find the multiple roots – nature and position of roots – Rolle’s theorem – Sturm’s theorem – finding Sturm’s function for the given polynomial **(18 hours)**
- Unit 3:** Cubic equations – Cardan’s method for solving a cubic equation – biquadratic equation – Ferrari’s method – approximate solutions of numerical equations – Newton’s method – Horner’s method **(18 hours)**
- Unit 4:** Expansion for trigonometric functions –  $\sin n\theta$ ,  $\cos n\theta$  and  $\tan n\theta$  in terms of  $\sin\theta$ ,  $\cos\theta$ ,  $\tan\theta$ , hyperbolic functions – Properties of hyperbolic functions – inverse hyperbolic functions and its properties – relationship between hyperbolic and trigonometric functions – Logarithm of complex numbers **(18 hours)**
- Unit 5:** Summation of trigonometric series – methods to find the sum of the series – difference method, angles in A.P method –  $C + iS$  method – Gregory series – problem **(18 hours)**

**Book for Study :**

Arumugam S. et al., *Theory of Equations and Trigonometry*, New Gamma Publishing House, Palayamkottai, 2020.

Unit 1 : Chapter 5	Sections	5.5
Unit 2 : Chapter 5	Sections	5.6 - 5.7
Unit 3 : Chapter 5	Sections	5.8 - 5.10
Unit 4 : Chapter 6	Sections	6.1 - 6.2
Chapter 7	Sections	7.1 - 7.2
Chapter 8	Section	8.1
Unit 5 : Chapter 9	Sections	9.1 - 9.4

**Books for Reference :**

1. Manickavasagam Pillai T.K., *Trigonometry for B.Sc. Mathematics Major*, S.Viswanathan(Publishers) Pvt. Ltd., Chennai, 2011.
2. Narayanan S., *Algebra Volume I and II*, Vijay Nicole Imprints Pvt, Ltd., Chennai, 2014.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of the course, the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Up to
CO1	Transform the equations using standard forms	K3
CO2	Compute multiple roots and Sturm's function of polynomial	K3
CO3	Employ suitable method of finding the approximate solutions to the equations	K3
CO4	Illustrate the relationship between hyperbolic and trigonometric functions	K3
CO5	Find solutions to summation of series by applying suitable method.	K3

K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6=Create

### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		2	2	2	2	2	22
CO2	3	3			2	2	2		2	2	2	2	2	22
CO3	3	3			2	2	2		2	2	2	2	2	22
CO4	3	3			2	2	2		2	2	2	2	2	22
CO5	3	3			2	2	2		2	2	2	2	2	22
Grand Total of Cos with POs & PSOs														110
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{110}{50}$														2.2

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.2
Observation	COs of Algebra & Trigonometry are strongly correlated with POs & PSOs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR**  
**DEPARTMENT OF MATHEMATICS**  
**Mathematical Statistics – I**

(For those who join from June 2022 onwards)

<b>Class</b>	<b>: B.Sc. Mathematics</b>	<b>Part</b>	<b>: III/Core-2</b>
<b>Semester</b>	<b>: I</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22UMAC21</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course aims in imparting the skills of applying statistical knowledge to real world problems

**Course Content:**

- Unit 1:** Correlation – Karl Pearson’s coefficient of correlation – rank correlation – regression – regression lines – regression coefficient **(18 hours)**
- Unit 2:** Theory of Attributes – Consistency of data – Independence and association of data – Yule’s coefficient of Association **(18 hours)**
- Unit 3:** Random variables – discrete and continuous – mathematical expectations – moment generating function – cumulant generating function – characteristic function **(18 hours)**
- Unit 4:** Binomial distribution – moments of binomial distribution – recurrence relation – fitting binomial distribution Poisson distribution – moments of a Poisson distribution – fitting a Poisson distribution **(18 hours)**
- Unit 5:** Normal distribution – moment generating function – standard normal variate – moment generating function of standard normal variate – cumulant generating function – area property of Normal distribution – fitting of Normal distribution – area method – ordinate method **(18 hours)**

**Book for Study :**

Arumugam S. et al., *Statistics*, New Gamma Publishing House, Palayamkottai, 2015.

Unit 1 :	Chapter 6	Sections	6.1-6.3
Unit 2 :	Chapter 8	Sections	8.1-8.3
Unit 3 :	Chapter 12	Sections	12.0-12.6
Unit 4 :	Chapter 13	Sections	13.1-13.2
Unit 5 :	Chapter 13	Section	13.3

**Books for Reference :**

1. S.C. Gupta, V.K. Kapoor., *Fundamentals of Mathematical Statistics (Theory and Practice)*, Sultan Chand & Sons educational publishers , New Delhi, 11<sup>th</sup> Edition, 2006
2. Sancheti D.C. and Kapoor V.K., *Statistics (Theory, Methods and Applications)*, Sultan Chand and Sons, New Delhi, 7<sup>th</sup> Edition, 2007.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Up to
CO1	Solve the problems of finding correlation and regression coefficients by choosing suitable methods	K3
CO2	Employ the principles of attributes to find solutions to real-life problems	K3
CO3	Find solutions to the problems based on random variables	K3
CO4	Differentiate the different kinds of distributions and solve related problems	K3
CO5	Apply the concepts of normal distributions to solve real life problems.	K3

K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PS O1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COswith POs & PSOs
CO1	3	3			2	2	2		3	2	3	2	2	24
CO2	3	3			2	2	2		3	2	3	2	2	24
CO3	3	3			2	2	2		3	2	3	2	2	24
CO4	3	3			2	2	2		3	2	3	2	2	24
CO5	3	3			2	2	2		3	2	3	2	2	24
Grand Total of Cos with POs & PSOs														120
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{120}{50}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.4
Observation	COs of Mathematical Statistics I are strongly correlated with POs & PSOs		



ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Allied Mathematics – I

(For those who join from June 2022 onwards)

Class	: B.Sc. Physics & Chemistry	Part	: III/Allied-1
Semester	: I	Hours	: 75
Course Code	: 22UMAB11	Credits	: 4

**Objectives:**

This course will facilitate the learners in acquiring intense knowledge and application skills of mathematical concepts to the problems related to their disciplinary subject.

**Course Content:**

- Unit 1:** Successive differentiation – $n^{\text{th}}$  derivative of  $e^{ax}$ ,  $\sin(ax+b)$ ,  $\cos(ax+b)$ ,  $e^{ax}\sin bx$ ,  $\log(ax+b)$ ,  $(ax+b)^{-1}$ - Leibnitz's theorem– problems **(15 hours)**
- Unit 2:** Curvature – radius of curvature – centre of curvature- radius of curvatures in polar form – p-r form- intrinsic form- pedal equation-evolutes **(15 hours)**
- Unit 3:** Expansion for trigonometric functions – $\sin n\theta$ ,  $\cos n\theta$  and  $\tan n\theta$ ,  $\sin n\theta$ ,  $\cos n\theta$ ,  $\sin\theta$ ,  $\cos\theta$ ,  $\tan\theta$ - hyperbolic functions – Properties of hyperbolic functions– inverse hyperbolic functions and its properties- relationship between hyperbolic and trigonometric functions- Logarithm of complex numbers **(15 hours)**
- Unit 4:** Theory of equations– relation between the roots and the coefficients – sum of the powers of the roots – reciprocal equations – reciprocal equation of first type-reciprocal equation of second type- methods to solve reciprocal equations **(15 hours)**
- Unit 5:** Numerical computation- Iteration method- Bisection method- Regula-Falsi method- Newton-Raphson method- Horner's method **(15 hours)**

**Book for Study:**

1. *Salai Parkunan T. et al., Allied Mathematics – I* (for Physics and Chemistry), Britto Publishing House, January 2013.  
Unit 1: Chapter 1 Sections 1.1-1.3.11  
Unit 2: Chapter 2 Sections 2.1-2.2.13  
Unit 3: Chapter 3 Sections 3.1 - 3.7.7  
Unit 4: Chapter 4 Sections 4.1- 4.5.14
2. *Numerical Methods, Second Edition*, S. Arumugam, A. Thangapandi Issac, A. Somasundram, SCITCH publications, 2009.  
Unit 5: Chapter 3 Sections 3.1-3.5

**Books for Reference:**

1. Veerarajan T., *Algebra and Trigonometry*, Yes Dee Publishing Pvt Ltd, Chennai, 2020.
2. Kanna M.L., *Differential Calculus*, Jai PrakashNath and Co, Meerut City, 2008.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Compute the successive derivatives of functions and apply Leibnitz's theorem.	K3
CO2	Determine the curvature in various forms and comprehend its nature.	K3
CO3	Illustrate the relationship between hyperbolic and trigonometric functions	K3
CO4	Identify the type of reciprocal equations and solve by using different methods	K3
CO5	Find numerical solutions to a system of equations by employing various numerical methods	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2	2	3	3	3	3	3	23
CO2	3	3			2	2	2	2	2	2	2	2	2	24
CO3	3	3			2	2	2	2	3	3	3	3	3	24
CO4	3	3			2	2	2	2	2	2	2	2	2	23
CO5	3	3			2	2	2	2	2	2	2	2	2	24
Grand Total of Cos with POs & PSOs														130
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{130}{55}$														2.36

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.36
Observation	Cos of Allied mathematics I are strongly correlated with POs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Calculus

(For those who join from June 2022 onwards)

Class	: B.Sc. Mathematics	Part	: III/Core - 3
Semester	: II	Hours	: 90
Course Code	: 22UMAC32	Credits	: 5

**Objective:**

This course intends to enhance the computation skills of the learners in the fields of differentiation, integration and their related domains

**Course Content:**

- Unit 1:** Higher Derivatives –  $n^{\text{th}}$  derivatives of some standard functions  $(ax+b)^m$ ,  $\log(ax+b)$ ,  $e^{ax}$ ,  $\sin(ax+b)$ ,  $\cos(ax+b)$ ,  $e^{ax}\sin(bx+c)$ ,  $e^{ax}\cos(bx+c)$  – Leibnitz's theorem and its applications **(18 hours)**
- Unit 2:** The pedal equations - curvature – radius of curvature – centre of curvature – radius of curvature in polar coordinates – evolutes – envelope **(18 hours)**
- Unit 3:** Maximum value of a function – minimum value of a function – necessary condition for extreme values – sufficient condition for extreme value – second order derivatives – application to problems **(18 hours)**
- Unit 4:** Evaluation of definite integral – Reduction formulae: reduction formula of some standard forms – double and triple integrals – Change of variables **(18 hours)**
- Unit 5:** Beta and Gamma functions – Properties and results involving Beta and Gamma functions-Duplication formula-Fourier series: Cosine series –sine series. Half range Fourier sine series- half range Fourier cosine series **(18 hours)**

**Books for Study:**

- Arumugam S. and Thangapandi Issac, *Calculus*, New Gamma Publishing House, Palayamkottai, 2011.

Unit 1	Chapter 2	Sections	2.11, 2.12	(part-1)
Unit 2	Chapter 3	Sections	3.3- 3.6	(part-1)
Unit 4	Chapter 2	Sections	2.6, 2.8	(part-2)
	Chapter 3	Sections	3.1-3.4	(part-2)
Unit 5	Chapter 4	Section	4.1	(part 2)
	Chapter 5	Sections	5.1, 5.2	(part 2)
- Shanti Narayan and Dr.P.K.Mittal, *Differential Calculus*, S.Chand & Company LTI, New Delhi, 2011

Unit 3	Chapter 9	Sections	9.1-9.5	
--------	-----------	----------	---------	--

**Books for Reference:**

- Manickavasgan Pillai T.K. and Narayanan S., *Calculus*, Volume I and II, S.Viswanathan (Publishers) Pvt.Ltd., Chennai, 2017.
- Kanna M.L., *Calculus – Differential and Integral*, Jai Prakash Nath and Company, Meerut City, 2009.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Compute the higher derivatives of functions and solve the problems using Leibnitz's theorem.	K3
CO2	Illustrate, determine and analyze the curvature and radius of curvature of various curves.	K3
CO3	Calculate maxima and minima of a functions and use second derivatives in solving problems	K3
CO4	Compute the definite integrals of various kinds by employing reduction formulae.	K3
CO5	Apply Beta and Gamma functions to evaluate integrals and express the given function as Fourier series	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2	2	2	2	23
CO2	3	3			2	2	2		3	2	3	2	2	24
CO3	3	3			2	2	2		3	2	3	2	2	24
CO4	3	3			2	2	2		3	2	2	2	2	23
CO5	3	3			2	2	2		3	2	3	2	2	24
Grand Total of Cos with POs & PSOs														118
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{118}{50}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.4
Observation	COs of Calculus are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR

DEPARTMENT OF MATHEMATICS

Mathematical Statistics – II

(For those who join from June 2022 onwards)

Class : B.Sc. Mathematics

Semester : II

Course Code : 22UMAC42

Part : III/Core-4

Hours : 90

Credits : 5

**Objective:**

This course aims in igniting the minds of the learners with profound knowledge and applications of inferential statistics

**Course Content:**

**Unit-I**

Introduction - types of sampling - tests of significance - procedure for testing of hypothesis - test of significance for large samples - sampling of attributes - sampling of variables (18 hours)

**Unit II**

Derivation of the chi-square distribution - MGF of chi-square distribution – test based on chi-square distribution – population variance – goodness of fit- independence of attributes (18 hours)

**Unit III**

Student's t - distribution –test for means – test the significance of an observed sample correlation - F-distribution – test for equality of two population variance (18 hours)

**Unit-IV**

Characteristics of estimators -Methods of Estimation – Method of Maximum Likelihood Estimation –Method of Minimum Variance - Method of Moments - Method of least squares (18 hours)

**Unit V**

Introduction – analysis of variance - one-way classification - two-way classification - Latin square (18 hours)

**Books for Study**

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11<sup>th</sup> thoroughly revised edition, Sultan Chand and Sons, 2006.

Unit 1 : Chapter 14 Sections 14.1-14.8

Unit 2: Chapter 15 Sections 15.1- 15.3, 15.6.1 – 15.6.3

Unit 3 : Chapter 16 Sections 16.1-16.3, 16.5-16.6.1

Unit 4: Chapter 17 Sections 17.1, 17.2, 17.6

2. Statistics, S. Arumugam and A. Thangapandi Issac, New Gamma Publishing house, 2011.

Unit 5: Chapter17 Sections 17.0-17.3

**Books for Reference:**

1. Gupta B.N., *Statistics (Theory and Practice)*, Sahitya Bhavan, Agra, 4th Edition, 2004.

2. Sancheti D.C. and Kapoor V.K., *Statistics (Theory, Methods and Applications)*, Sultan Chand and Sons, New Delhi, 7th Edition, 2007.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Differentiate between the types of sampling and apply the tests of significance	K3
CO2	Make use of $\chi^2$ distribution and determine the results to draw conclusions.	K3
CO3	Employ suitable tests of significance to small samples.	K3
CO4	Explain the significance of estimation and compute solutions to the real life problems.	K3
CO5	Apply analysis of variance and Latin square to solve problems and analyze the results	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2	3	2	2	24
CO2	3	3			2	2	2		3	2	3	2	2	24
CO3	3	3			2	2	2		3	2	3	2	2	24
CO4	3	3			2	2	2		3	2	3	2	2	24
CO5	3	3			2	2	2		3	2	3	2	2	24
Grand Total of Cos with POs & PSOs														120
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{120}{50}$														2.4

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.4
Observation	COs of Mathematical Statistics II are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Allied Mathematics – II

(For those who join from June 2022 onwards)

Class	: B.Sc. Physics & Chemistry	Part	: III/Allied-2
Semester	: II	Hours	: 75
Course Code	: 22UMAB22	Credits	: 4

**Objectives:**

This course will facilitate the learners in acquiring intense knowledge and application skills of mathematical concepts to the problems related to their disciplinary subject.

- Unit 1:** Reduction formulae – Beta and Gamma functions – Properties and result involving beta and gamma functions – the relation between Beta and Gamma function—duplication formula-Fourier series: the cosine and sine series -half range Fourier series **(15 hours)**
- Unit 2:** Vector calculus – differentiation of vectors – directional derivatives – gradient, divergence and curl and their properties – directional derivatives – solenoidal and irrotational fields **(15 hours)**
- Unit 3:** Vector integration – line, surface and volume integrals – Green’s, Stoke’s and Gauss theorems (Statements only) and their applications **(15 hours)**
- Unit 4:** Exact differential equations – equations of first order but of higher degree – solvable for p, y and x – Clairaut’s equations – problems **(15 hours)**
- Unit 5:** Laplace transforms –Inverse Laplace transforms- properties- problems- applications of Laplace transforms – solving second order and simultaneous differential equations **(15 hours)**

**Book for Study:**

*Allied Mathematics – II (for Physics and Chemistry)*, prepared by Department of Mathematics, Arul Anandar College (Autonomous), Madurai, Britto Publishing House, January 2013.

Unit 1: Chapter 1	Sections	1.1 -1.3
Unit 2: Chapter 2	Sections	2.1- 2.5
Unit 3: Chapter 3	Sections	3.1- 3.3
Unit 4: Chapter 4	Sections	4.1-4.5
Unit 5: Chapter 5	Sections	5.1-5.4

**Books for Reference:**

1. Manickavasgan Pillai T.K. and Narayanan S., *Calculus*, Volume I and II, S.Viswanathan (Publishers) Pvt. Ltd., Chennai, 2017.
2. Sankara Narayanan, *Differential Equations and Applications*, Suja Publishers, Palayamkottai, 2011.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level upto
CO1	Apply Beta and Gamma functions to evaluate integrals and express the given function as Fourier series	K3
CO2	Explain and find the derivatives of vector valued functions.	K3
CO3	Use the results of the theorems on vector integration in evaluating the integrals.	K3
CO4	Apply the suitable method and solve differential equations.	K3
CO5	Employ the Laplace and inverse Laplace transforms to solve differential equations	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	3	3			2	2	2		3	3	3	3	3
CO2	3	3			2	2	2		2	2	2	2	2
CO3	3	3			2	2	2		3	3	3	3	3
CO4	3	3			2	2	2		2	2	2	2	2
CO5	3	3			2	2	2		2	2	2	2	2

Strong – 3, Medium – 2, Low-1



**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**

**DEPARTMENT OF MATHEMATICS**

**QUESTION PAPER PATTERN (UG)**

(Core, Core Elective and Non-Major Elective)

(For those who join from 2022 onwards)

**INTERNAL (40 MARKS)**

**SECTION – A (4 x 1 = 4 marks)**

FOUR multiple choice questions. Each question carries one mark. (K1, K2)

**SECTION – B (2 x 4 = 8 marks)**

TWO questions with internal choice. Each question carries four marks. (K3, K4)

**SECTION – C (4 x 7 = 28 marks)**

FOUR questions with internal choice. Each question carries seven marks. (K3, K4, K5)

DEPARTMENT OF MATHEMATICS

SCHEME OF EVALUATION (UG)

1. Continuous Internal Assessment

	Marks
Test – 1	40
Test – 2	40
Assignment / Seminar	20
	-----
Total	100
	-----

2. Semester Examination                      100 Marks

3. Total Marks = 50% C.I.A + 50% Semester Examinations

A candidate must score a minimum of 20 marks out of 50 in the semester examination and an overall aggregate minimum of 40 marks out of 100 for a pass.



On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Explain the definitions of the fundamental concepts of sequences with examples	K2
CO2	Find the limit of sequences and illustrate the nature of Cauchy sequences	K2
CO3	Analyze the nature of series by applying various tests.	K4
CO4	Apply different kinds of test of convergence for series	K3
CO5	Use the tests of convergence of series of arbitrary terms	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

Mapping Course outcome with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2			3	2		2	2	19
CO2	3	3			2	2			3	2		2	2	19
CO3	3	3			2	3			3	3		2	2	21
CO4	3	3			2	2			3	2		2	2	19
CO5	3	3			2	2			3	2		2	2	19
Grand Total of Cos with POs & PSOs														97
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{97}{40}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.4
Observation	COs of Sequences & Series are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Analytical Geometry of 3D and Vector Calculus

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class : II B.Sc. Mathematics

Part : III/ Allied - 3

Semester : III

Hours : 75

Course Code : 22UMAA33

Credits: 4

**Objective:**

This course will make the learners acquire intense knowledge on solving problems associated with three dimensional objects, vector differentiation and vector integration and also gain hands on experience in solving problems using Geogebra software.

**Course Content:**

- Unit 1:** Planes : Equation of a plane – angle between two planes – angle bisectors of two planes – hands on training on solving problems based on planes using Geogebra (15 hours)
- Unit 2:** Straight lines : Equation of a straight line – non-symmetric form – symmetric form – two points form – plane and a line – skew lines –equation of two skew lines in a simple form – intersection of three planes – hands on training on solving problems based on straight lines using Geogebra (15 hours)
- Unit 3:** The Sphere: Equation of a sphere – centre radius form – general form of a sphere – diameter form – tangent line and tangent plane – angle of intersection of two spheres – section of a sphere– hands on training on solving problems based on sphere using Geogebra (15 hours)
- Unit 4:** Vector Differentiation: Vector algebra – differentiation of vectors –gradient – geometrical interpretation – equation of the tangent plane – equation of the normal line – divergence and curl– harmonic vector. (15 hours)
- Unit 5:** Line and Surface Integrals: Line integrals – work done by a force – surface integrals – theorems of Green, Gauss and Stokes (15 hours)

**Book for Study:**

S.Arumugam and A.Thangapandi Isaac, Analytical Geometry 3D and Vector Calculus, New Gamma Publishing House,2018.

Unit 1	:	Chapter 2	Section 2.1-2.21
Unit 2	:	Chapter 3	Section 3.1-3.44
Unit 3	:	Chapter 4	Section 4.1-4.21
Unit 4	:	Chapter 5	Section 5.1-5.28
Unit 5	:	Chapter 7	Section7.1-7.29

**Books for Reference:**

1. K.Manicavachagom Pillay and T.Natarajan, S.Viswanathan, Analytical Geometry Part II – Three Dimensions by Printers & Publishers Pvt. Ltd. 2017.
2. S.Narayanan and T.K.Manicavachagom Pillay, S.Viswanathan, Vector Calculus by Printers & Publishers Pvt. Ltd. 2017.

### Teaching Learning Methods:

- Lecture Method, Assignment, Quiz, Group Discussion

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Up to
CO1	Find the equation of plane and compute the angle between the planes	K3
CO2	Classify skew lines and coplanar lines; compute the shortest distance between lines	K3
CO3	Construct the equation of the sphere of various forms and its section.	K3
CO4	Employ vector differentiation to calculate the gradient of functions and categorize vectors	K3
CO5	Apply the fundamental theorems of calculus to find the relationship between different types of integrals	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

### Mapping Course outcome with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2			3	2	3	2	2	22
CO2	3	3			2	2			3	2	3	2	2	22
CO3	3	3			2	2			3	2	3	2	2	22
CO4	3	3			2	2			3	2	3	2	2	22
CO5	3	3			2	2			3	2	3	2	2	22
Grand Total of Cos with POs & PSOs														110
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{110}{45}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.4
Observation	COs of Analytical Geometry of 3D & Vector Calculus are strongly correlated with POs & PSOs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625 514**

**DEPARTMENT OF MATHEMATICS**

**Mathematics for Competitive Examinations**

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

**Class : II B.A. (Arts)**

**Part : IV/NME-1**

**Semester : III**

**Hours : 45**

**Course Code : 22UMAN13**

**Credits : 2**

**Objective:**

This course intends to make the learners gain competency of solving problems in competitive examinations.

**Course Content:**

**Unit 1:** Highest common factor – factorized method – division method - least common multiple – factorized method – shortcut method **(9 hours)**

**Unit 2:** Simplification - various algebraic formulas and their applications – simplify the rule of BODMAS – square roots– cube roots **(9 hours)**

**Unit 3:** Percentage- results on population – result on depreciation – reduction percentage **(9 hours)**

**Unit 4:** Chain rule –Ratio - Proportion - Direct proportion – Indirect proportion **(9 hours)**

**Unit 5:** Calendar-odd days-leap Year-ordinary Year-counting of odd days-day of the week related to odd days. **(9 hours)**

**Book for Study**

R.S. Aggarwal, “Quantitative Aptitude”, revised edition, S.Chand & Company Ltd, New Delhi, 2017.

Unit 1 :	Chapter 2
Unit 2 :	Chapters 4 & 5
Unit 3 :	Chapter 11
Unit 4 :	Chapter 14
Unit 5 :	Chapter 27

**Books for Reference:**

01. Ashish Aggarwal, “Quick Arithmetic”, First Edition, S.Chand & Company Ltd., New Delhi, 2014.
02. Dinesh Khattar, “The Pearson Guide to Quantitative Aptitude”, Third Edition, Dorling Kindersley Private Limited, New Delhi, 2010.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Up to
CO1	Employ various methods to find H.C.F and L.C.M.	K3
CO2	Apply various algebraic formulae in computing solutions to the problems	K3
CO3	Solve real life problems using the notion of percentage	K3
CO4	Use the aspects of chain rule to compute solutions to the problems.	K3
CO5	Compute solutions to the problems based on calendar	K3

**K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create**

**Mapping Course outcome with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2			2	2			3	3	3	3	3	23
CO2	3	2			2	2			2	2	2	2	2	24
CO3	3	2			2	2			3	3	3	3	3	24
CO4	3	2			2	2			2	2	2	2	2	23
CO5	3	2			2	2			2	2	2	2	2	24
Grand Total of Cos with POs & PSOs														105
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{118}{45}$														2.33

**Strong – 3, Medium – 2, Low – 1**

<b>Mapping Scale</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Relation</b>	<b>0.01-1.0</b>	<b>1.01-2.0</b>	<b>2.1-3</b>
<b>Quality</b>	<b>Low</b>	<b>Medium</b>	<b>Strong</b>
<b>Mean Value of Cos with POs &amp; PSOs</b>			<b>2.33</b>
<b>Observation</b>	<b>CoS of Mathematics for Competitive examinations are strongly correlated with POs</b>		



ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Solar system

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class : II UG Part : SLC

Semester : III Credits : 3

Course Code : 22UMASL3

**Objective:**

This course enables the learners to gain more insights on solar structure and elements of solar system

**Course outline:**

**Unit 1:** Introduction – planetesimal hypothesis – surface structure of the sun – solar constant

**Unit 2:** Surface structure of mercury - Venus and Mars

**Unit 3:** Discovery of the minor planets – Asteroids – surface structure of Jupiter and Saturn.

**Unit 4:** Discoveries of Uranus, Neptune and Pluto

**Unit 5:** Meteors – zodiacal light – difference between the planets and comets

**Book for Study:**

Kumaravelu, Susheela Kumaravelu, "Astronomy", Reprinted, Sri Vishnu Arts, 2004.

Unit 1: Chapter 14 sections 321, 322

Unit 2: Chapter 14 sections 323 - 325

Unit 3: Chapter 14 sections 326 - 328

Unit 4: Chapter 14 sections 329 - 331

Unit 5: Chapter 14 sections 332 – 334

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

On completion of this course the student will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Retrieve the fundamentals of solar structure	K1
CO2	Summarize the features of planets	K2
CO3	Explain the structure of minor planets	K2
CO4	Explicate the composition of outer most planets	K2
CO5	Describe the differences between planets , meteors and comets	K2

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

Mapping Course outcome with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2		2		2			2		2		2	15
CO2	3	2		2		2			2		2		2	15
CO3	3	2		2		2			2		2		2	15
CO4	3	2		2		2			2		2		2	15
CO5	3	2		2		2			2		2		2	15
Grand Total of Cos with POs & PSOs														75
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{75}{35}$														2.14

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.14
Observation	Cos of Solar system are strongly correlated with POs		

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

<b>Class</b>	<b>: II B.Sc. Mathematics</b>	<b>Part</b>	<b>: III/Core-6</b>
<b>Semester</b>	<b>: IV</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22UMAC64</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course aims in making the students acquire profound knowledge and applications of the changes in physical systems both under rest and motion.

**Course Content:**

- Unit 1: Forces acting at a point:** Resultant and components – simple cases of finding the resultant – parallelogram of forces – analytical expression for the resultant of two forces acting at a point– Triangle of forces – perpendicular Triangle of forces – converse of the Triangle of forces – polygon of forces – Lami’s theorem – extended form of parallelogram law of forces –resolution of a force –component of a force along two given directions –theorem on resolved parts –resultant of any number of forces acting at a point –resultant of coplanar forces – conditions of equilibrium of any number **(18 hours)**
- Unit 2: Parallel forces and Moments :** Resultant of two like parallel forces acting on a rigid body – resultant of two unlike and unequal parallel forces acting on a rigid body – resultant of a number of parallel forces acting on a rigid body – condition of equilibrium of three coplanar parallel forces – centre of two parallel forces – moment of a force– physical significance of the moment of a force – sign of the moment – unit of moments – Varignon’s theorem of moments –generalized theorem of moments **(18 hours)**
- Unit 3: Stability of Equilibrium:** Stable, unstable and neutral equilibrium- nature of equilibrium of a rigid body supported at one fixed point- conditions of stability for a body with one degree of freedom-stability of rocking stones – important particular cases **(18 hours)**
- Unit 4: Projectiles :** Two fundamental principles – path of a projectile is a parabola – characteristics of the motion of projectile – particle projected horizontally from a certain height – maximum horizontal range of the projectile with velocity and magnitude of projection – two possible directions of projections with initial velocity – velocity and magnitude of the projectile at the end of time –velocity of the projectile for a freely falling body –two directions of projection **(18 hours)**
- Unit 5: Collision of Elastic Bodies:** Fundamental law of Impacts – Newton’s experimental law – motion of two smooth bodies perpendicular to the line of impact – Principle of conservative momentum –impact of a smooth spheres on a fixed smooth plane

– Direct impact of two smooth spheres- loss of kinetic energy due to impact of two smooth spheres – **(18 hours)**

**Books for study:**

01. Venkatraman, M.K., "Statics, Eighteenth Edition", Agasthiar Publications, Trichy, 2016.

Unit 1 : Chapter 2 Sections 1 – 16

Unit 2 : Chapter 3 Sections 1 – 13

Unit 3 : Chapter 10 Sections 1 – 4

02. Venkatraman, M.K., "Dynamics, Eighteenth Edition", Agasthiar Publications, Trichy, 2016.

Unit 4 : Chapter 6 Sections 6.1 – 6.11

Unit 5 : Chapter 8 Sections 8.1 – 8.6

**Books for Reference:**

01. Duraipandian, P., Laxmi Duraipandian and Muthamizh Jayapragasm, "Mechanics", S.Chand and Company, 2003.

02. Narayanan, S., "Dynamics", S.Chand and Company, 16th Edition, New Delhi, 1986.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Explain various laws of forces and solve problems by applying the same	K3
CO2	Compare like and unlike parallel forces and employ Varignon's theorem in solving problems	K3
CO3	Use the concepts of stability of equilibrium in solving problems	K3
CO4	Explicate projectile and apply its properties to solve problems	K3
CO5	Apply the concept of impulsive forces in finding solutions to the problems	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

**Mapping Course outcome with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2			3		3		2	18
CO2	3	3			2	2			3		3		2	18
CO3	3	3			2	2			3		3		2	18
CO4	3	3			2	2			3		3		2	18

<b>CO5</b>	3	3			2	2			3		3		2	18
Grand Total of Cos with POs & PSOs													90	
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{90}{35}$													2.6	

**Strong – 3, Medium – 2, Low – 1**

<b>Mapping Scale</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Relation</b>	<b>0.01-1.0</b>	<b>1.01-2.0</b>	<b>2.1-3</b>
<b>Quality</b>	<b>Low</b>	<b>Medium</b>	<b>Strong</b>
<b>Mean Value of Cos with POs &amp; PSOs</b>			<b>2.6</b>
<b>Observation</b>	<b>Cos of Mechanics are strongly correlated with POs &amp; PSOs</b>		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625514

DEPARTMENT OF MATHEMATICS

Differential Equations and Applications

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class	: II B.Sc. Mathematics	Part	: III/Allied-4
Semester	: IV	Hours	: 75
Course Code	: 22UMAA44	Credits	: 4

**Objective:**

This course will make the learners to gain knowledge in applying different methods of solving differential equations.

**Course Content:**

- Unit 1:** **Equation of first order & higher degree:** Bernoulli's Equation-Exact differential equations – Practical rule for solving an exact differential equation-equations of first order but of higher degree – equations solvable for  $x, y$  and  $p$  – Clairaut's equation-Equations that do not contain  $x$  explicitly **(15 hours)**
- Unit 2:** **Linear equation with constant coefficients:** – The operator  $D$ -complementary function of a linear equation with constant coefficients-particular integral-general method for finding P.I-special methods for finding P.I- linear equations with variable coefficients – equations with reducible to the linear equations **(15 hours)**
- Unit 3:** **Simultaneous differential equations:** simultaneous equations of first order and first degree- solutions of Lagrange's equations -Methods for solving Lagrange's equations- simultaneous linear differential equations-simultaneous equation with variable coefficients. **(15 hours)**
- Unit 4:** **The Laplace transforms:** sufficiently conditions for the existence of the Laplace transform-Laplace transform of periodic functions- The inverse transform – solution of differential equations using Laplace transforms. **(15 hours)**
- Unit 5:** **Applications of first order equations:** Growth, Decay and Chemical Reactions – Flow of water from an orifice-simple electric circuits**(15 hours)**

**Book for Study:**

S.Narayanan, T.K.Manickavachagam Pillay," Differential Equations and its Applications", S.Viswanathan ( Printers & Publishers), PVT., LTD.2018

Unit 1	:	Chapter 2	sections 5, 6
		Chapter 4	sections 1, 2, 3
Unit 2	:	Chapter 5	sections 1-6
Unit 3	:	Chapter 6	sections 1-7
Unit 4	:	Chapter 9	sections 1-7
Unit 5	:	Chapter 3	sections 1, 2 & 6

**Books for Reference:**

1. Arumugam and Issac, "Differential Equations and Applications", New Gamma Publishing House, Palayamkottai, 2014.
2. M.L Khanna, "Differential Equations", Jai Prakashnath & Co, Meerut, 1999.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Compute solutions to differential equations of many kinds by applying various methods	K3
CO2	Apply the method of variation of parameters to solve linear differential equations.	K3
CO3	Employ the properties of Laplace transforms to solve differential equations	K3
CO4	Use Lagrange's and Charpit's methods to solve the partial differential equations	K3
CO5	Formulate and solve the differential equation representing the real life problems	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

**Mapping Course outcome with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3		2	2				3	2	2	2	2	21
CO2	3	3		2	2				3	2	2	2	2	21
CO3	3	3		2	2				3	2	2	2	2	21
CO4	3	3		2	2				3	2	2	2	2	21
CO5	3	3	2	2	2				3	2	2	2	2	23
Grand Total of Cos with POs & PSOs														107
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{107}{46}$														2.3

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.3
Observation	COs of Differential Equations and Applications are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625 514

DEPARTMENT OF MATHEMATICS

Resource Optimization Techniques

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class : II B.Sc. (Other Sciences)

Part : IV/NME-2

Semester : IV

Hours : 45

Course Code : 22UMAN24

Credits : 2

**Objective:**

This course enables the learners acquire intense knowledge and apply different optimization techniques to real life problems.

**Course Content:**

**Unit 1: Linear programming problem:** Introduction – Linear Programming Problem - Mathematical formulation of Problem - Graphical solution method.

**(9 hours)**

**Unit 2: Transportation problem:** Introduction – LP formulation of transportation problem- Solution of a transportation problem – Finding an initial basic feasible solution.

**(9 hours)**

**Unit 3: Assignment problem:** Introduction – mathematical formulation of assignment problem – solution to an assignment problem – Travelling salesman problem.

**(9 hours)**

**Unit 4: Sequencing problem:** Introduction - Problem of sequencing – Basic Terms used in sequencing – Processing n jobs through two machine – Processing n jobs through k machines.

**(9 hours)**

**Unit 5: Games and Strategies:** Introduction- Two-person Zero-sum Games - The Maximin - Minimax principle –Games without saddle points –mixed strategies.

**(9 hours)**

**Book for Study:**

Kanti Swarup., Gupta P.K., Man Mohan “An introduction to management science operation research” Sultan Chand and sons educational publishers, new Delhi, fifteenth edition

Unit 1 : Chapters 2,3 Sections: 2.1,2.4,3.2

Unit 2 : Chapter 10 Sections: 10.1,10.2,10.8,10.9

Unit 3 : Chapter 11 Sections: 11.1 – 11.3,11.7

Unit 4 : Chapter 12 Sections: 12.1 – 12.5

Unit 5 : Chapter 17 Sections: 17.1 – 17.5

**Books for Reference:**

01. Sharma., “Operations Research”, 2<sup>nd</sup> Edition, Vikas Publishing House Private Limited, NewDelhi, 2002.

02. Arumugam.S., Thangapandi Isaac.A “Topics in operation research Linear programming” New gamma publishing house, Palayamkottai, March 2015.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion



On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Define and formulate linear programming problems and apply graphical method	K3
CO2	Be able to build and solve transportation models	K3
CO3	Use different methods to solve the assignment problems.	K3
CO4	Solve problems based on sequencing	K3
CO5	Apply game strategies to solve problems	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

Mapping Course outcome with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2			2	2			3	3	3	3	3	23
CO2	3	2			2	2			2	2	2	2	2	24
CO3	3	2			2	2			3	3	3	3	3	24
CO4	3	2			2	2			2	2	2	2	2	23
CO5	3	2			2	2			2	2	2	2	2	24
Grand Total of Cos with POs & PSOs														105
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{118}{45}$														2.33

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.33
Observation	Cos of Operations Research Techniques are strongly correlated with POs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Stellar Universe

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class : II UG

Part : SLC

Semester : IV

Credits: 3

Course Code : 22UMASL4

**Objectives:**

This course enables the learners to acquire profound knowledge on stellar universe

**Course Content:**

**Unit 1:** Introduction – stellar motion – solar motion - distance of stars – magnitudes of stars

**Unit 2:** Apparent visual and photo visual magnitude/absolute magnitude

**Unit 3:** Colour and size of stars – dwarfs – main sequence stars – giants

**Unit 4:** Double and multiple stars – variable stars – novae – nebulae

**Unit 5:** Zodiacal constellations – winter, spring, summer, autumn constellations

**Book for Study:**

Kumaravelu, Susheela Kumaravelu, "Astronomy", Reprinted, Sri Vishnu Arts, 2004.

Unit 1 : Chapter 17 sections: 335 - 339

Unit 2 : Chapter 17 sections: 340 - 342

Unit 3 : Chapter 17 sections: 343

Unit 4 : Chapter 17 sections: 344 - 348

Unit 5 : Chapter 17 sections: 349 – 352

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level
CO1	Retrieve the fundamentals of solar and stellar systems	K1
CO2	Summarize the magnitude of apparent and photo visuals	K2
CO3	Explain the formation of stars	K2
CO4	Explicate the different types of stars	K2
CO5	Describe zodiacal constellations of different seasons	K2

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 Create

### Mapping Course outcome with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
<b>CO1</b>	3	2		2		2			2		2		2	15
<b>CO2</b>	3	2		2		2			2		2		2	15
<b>CO3</b>	3	2		2		2			2		2		2	15
<b>CO4</b>	3	2		2		2			2		2		2	15
<b>CO5</b>	3	2		2		2			2		2		2	15
Grand Total of Cos with POs & PSOs														75
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{75}{35}$														2.14

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.14
Observation	Cos of Stellar Universe are strongly correlated with POs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**

**DEPARTMENT OF MATHEMATICS**

**QUESTION PAPER PATTERN (UG)**

(Core, Core Elective, Allied and Non-Major Elective)

(For those who join from 2022 onwards)

**INTERNAL (40 MARKS)**

**SECTION – A (4 x 1 = 4 marks)**

FOUR multiple choice questions. Each question carries one mark. (K1, K2)

**SECTION – B (2 x 4 = 8 marks)**

TWO questions with internal choice. Each question carries four marks. (K3, K4)

**SECTION – C (4 x 7 = 28 marks)**

FOUR questions with internal choice. Each question carries seven marks. (K3, K4, K5)

---

**EXTERNAL (100 MARKS)**

**SECTION – A (10 x 1 = 10 marks)**

TEN multiple choice questions. Each question carries one mark. (K1, K2)

**SECTION – B (5 x 6 = 30 marks)**

FIVE questions with internal choice. Each question carries six marks. (K3, K4)

**SECTION – C (5 x 12 = 60 marks)**

FIVE questions with internal choice. Each question carries twelve marks. (K3, K4, K5)

DEPARTMENT OF MATHEMATICS

SCHEME OF EVALUATION (UG)

1. Continuous Internal Assessment

	Marks
Test – 1	40
Test – 2	40
Assignment / Seminar	20
	-----
Total	100
	-----

2. Semester Examination                      100 Marks

3. Total Marks = 50% C.I.A + 50% Semester Examinations

A candidate must score a minimum of 20 marks out of 50 in the semester examination and an overall aggregate minimum of 40 marks out of 100 for a pass.

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Modern Algebra

(For those who join from June 2022 onwards)

Class : III B.Sc. Mathematics

Part : III/Core 7

Semester : V

Hours : 90

Course Code : 22UMAC75

Credits: 5

**Objective:**

This course enables the students to gain profound knowledge on the various characteristics of Groups and Rings.

**Unit 1 Group Theory**

Groups- definition and examples – Abelian groups – permutation groups – subgroups- cyclic groups – definitions – intersection and union of two groups – order of a group and order of an element. (18 hours)

**Unit 2 Cosets**

Cosets and Lagrange's theorem – theorems of Euler and Fermat – normal subgroups – center of a group – quotient groups – Cayley's theorem – homomorphism – fundamental theorem. (18 hours)

**Unit 3 Ring Theory**

Rings – definition and examples – types of rings – zero divisors – integral domain – field – finite integral domain – characteristic of a ring. (18 hours)

**Unit 4 Sub Rings**

Sub rings-definition and examples – ideals – principal ideal – principal ideal domain – quotient rings – maximal and prime ideals. (18 hours)

**Unit 5 Unique factorization domain**

Homomorphism of rings – fundamental theorem – unique factorization domain-Euclidean domain-Every PID is unique factorization domain. (18 hours)

**Book for Study**

Arumugam S., Thangapandi Issac A., *Modern Algebra*, SCITECH Publications (India) Pvt Ltd., Chennai, 2018.

Unit 1 : Chapter 3	Sections: 3.0 - 3.7
Unit 2 : Chapter 3	Sections: 3.8 - 3.11
Unit 3 : Chapter 4	Sections: 4.1 - 4.5
Unit 4 : Chapter 4	Sections: 4.6 - 4.9
Unit 5 : Chapter 4	Sections: 4.10, 4.13 - 4.15

**Books for Reference:**

1. Surjeet Singh, Qazi Zameerudin, *Modern Algebra*, Vikas Publishing House Private Limited, New Delhi, 2012.
2. Vasishtha A.R., *Modern Algebra*, Krishna Prakasham Mandir, Meerut, 2013.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Describe the concept of group and its properties	K2
CO2	Explain the concept of cosets, normal subgroups, homomorphism and illustrate the implication of Lagrange's theorem	K3
CO3	Examine the characteristics of ring and compare its types	K4
CO4	Make inferences of the relationship between various kinds of ideals	K4
CO5	Analyze the properties of integral domain and unique factorization domain	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	3	2	2	2	24
CO2	3	3			2	2	2		3	2	2	2	2	23
CO3	3	3			2	2	2		3	3	2	2	2	24
CO4	3	3			2	2	2		3	2	2	2	2	23
CO5	3	3			2	2	2		3	3	2	2	2	24
Grand Total of COs with POs & PSOs														118
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{118}{50}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	COs of Modern Algebra are strongly correlated with POs & PSOs		

DEPARTMENT OF MATHEMATICS

Real Analysis

(For those who join from June 2022 onwards)

Class : III B.Sc. Mathematics Part : III/ Core 8  
Semester : V Hours : 90  
Course Code : 22UMAC85 Credits: 5

**Objective :**

This course makes the learners to acquire comprehensive understanding of the metric properties of the real line

**Course Outline:**

**Unit 1 Metric Spaces & Open sets**

Definition and examples of metric spaces – bounded sets – open ball – open sets – equivalent metrics – subspaces (18 hours)

**Unit 2 Interior of a set & Closed sets**

Interior of a set – closed sets – closed ball – examples – closure – limit points – derived set – dense sets (18 hours)

**Unit 3 Completeness**

Definition and examples – Cantor's intersection theorem – Baire's category theorem (18 hours)

**Unit 4 Continuity**

Homeomorphisms – Connectedness- Connected subsets of  $\mathbb{R}$  - Compactness – compact subsets of  $\mathbb{R}$  – Heine-Borel theorem (18 hours)

**Unit 5 L'Hospital's Theorem**

The indeterminate form  $(0/0)$  – L'Hospital's Theorem – The indeterminate form  $(\infty/\infty)$  – Application of L'Hospital's rule for  $\infty/\infty$  form - The indeterminate form  $0 \times \infty$  - The indeterminate form  $\infty - \infty$  - The indeterminate forms  $0^0$ ,  $\infty^0$  and  $1^\infty$  (18 hours)

**Books for Study**

1. Arumugam S., Thangapandi Issac A., *Modern Analysis*, New Gamma Publishing House, Palayamkottai, 2019.

Unit 1 : Chapter 2 Sections: 2.1 – 2.6  
Unit 2 : Chapter 2 Sections: 2.7 – 2.11  
Unit 3 : Chapter 3 Sections: 3.1 – 3.3  
Unit 4 : Chapter 4 Sections : 4.1 – 4.3  
Chapter 5 Sections : 5.1, 5.3  
Chapter 6 Sections : 6.1 – 6.3

2. Shanti Narayan & Dr.M.D.Raisinghania , *Elements of Real Analysis*, S.Chand & Company Pvt.Ltd., New Delhi, 2008.

Unit 5: Chapter 12

**Books for Reference:**

1. Viswanaha Naik.K., *Real Analysis*, Emerald Publishers, Chennai, 2013.



2. T.M.Apostal, *Mathematical Analysis*, Second Edition, Norosa Publishing House, New Delhi.
3. M. K. Singal & Asha Rani Singal, *A First Course in Real Analysis*, R. Chand & Co., 2008

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Describe the concept of metric spaces and open sets	K2
CO2	Examine the nature of open sets and closedsets	K4
CO3	Make inferences on completeness and its related theorems	K4
CO4	Analyze the properties of continuity and compactness	K4
CO5	Apply L'Hospital's Theorem to determine the value of the given indeterminate form	K3

**K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create**

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2		2	3	22
CO2	3	3			2	2	2		3	2		3	3	23
CO3	3	3			2	2	2		3	2		2	3	22
CO4	3	3			2	2	2		3	2	3	2	2	24
CO5	3	3			2	2	2		3	2		2	3	22
Grand Total of Cos with POs & PSOs														113
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{113}{46}$														2.5

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.5
Observation	COs of Real Analysis are strongly correlated with POs & PSOs		

Class : III B.Sc. Mathematics

Part : III/ Core 9

Semester : V

Hours : 60

Course Code : 22UMAC95

Credits: 4

**Objective:**

This course facilitates the learners develop the skill of solving problems numerically with computer applications.

**Course Outline:**

**Unit 1: Algebraic and Transcendental equations**

Solution of Algebraic and Transcendental equations - Bisection method - Method of false position - Iteration method - Newton-Raphson method-Ramanujan's method - The Secant method (12 hours)

**Unit 2: Interpolation**

Interpolation – errors in polynomial interpolation – finite differences – Newton's formulae for interpolation – central difference interpolation formula - Lagrange's interpolation formula – error in Lagrange's interpolation formula (12 hours)

**Unit 3: Numerical differentiation and Integration**

Numerical differentiation – differentiation using Newton's formulae and Stirling's central difference formula – maxima and minima – numerical integration –Trapezoidal rule – Simpson's one - third and three - eight rules (12 hours)

**Unit 4: Object Oriented Programming**

Principles of object oriented Programming – introduction to C++ – tokens – keywords– identifiers and constants – data types – expressions and control structures (12 hours)

**Unit 5: Functions in C++**

Functions – function prototyping – call by reference – return by reference – functionoverloading (12 hours)

**Books for Study:**

1. Sastry, S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall of India Private limited, New Delhi, 2019

Unit 1 : Chapter 2 Sections : 2.1-2.7

Unit 2 : Chapter 3 Sections : 3.1 – 3.4, 3.6, 3.7, 3.9.1, 3.9.2

Unit 3 : Chapter 5 Sections : 5.1 – 5.4

2. Balagurusamy E, *Object-Oriented Programming with C++*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

Unit 4 : Chapters 1 & 3 Sections : 1.4 – 1.6, 3.1 – 3.25

Unit 5 : Chapter 4 Sections : 4.1 – 4.12

**Books for Reference:**

1. Dr.Venkataraman M.K., *Numerical Methods in Science and Engineering*, The National Publishing Company, Chennai, 2013.
2. Veerarajan, T and Ramachandran, T, *Theory and problems in numerical methods with programs in C and C++*, Tata McGraw Hill Publishing Company Limited, New Delhi, 2004

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Solve Algebraic and Transcendental equations using different methods	K3
CO2	Apply the difference operators and the use of interpolation	K3
CO3	Use various methods to find the derivative of mathematical function	K3
CO4	Apply the characteristics of object oriented programming languages	K3
CO5	Write programs using function prototyping and function overloading	K3

**K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create**

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3		2	2	3	2		3	2	3	2	2	27
CO2	3	3		2	2	3	2		3	2	3	2	2	27
CO3	3	3		2	2	3	2		3	2	3	2	2	27
CO4	3	3		2	2	3	2		3	2	3	2	2	27
CO5	3	3		2	2	3	2		3	2	3	2	2	27
Grand Total of Cos with POs & PSOs														135
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{135}{55}$														2.5

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.5
Observation	COs of Numerical Methods using Computer Applications are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Numerical Methods using C++ Lab

(For those who join from June 2022 onwards)

Class : III B.Sc. Mathematics

Part : III /Core Lab-1

Semester : V

Hours : 30

Course Code : 22UMAP15

Credits : 1

**Objective :**

This course intends to make the learners construct new programs using C++ to compute solutions to the numerical problems

**Course Outline:**

**List of Programs**

Write a C++ program

1. To solve an equation using bisection method.
2. To determine the roots of an equation using Newton – Raphson method.
3. To find the roots of an equation using secant method.
4. To find the missing data using the Newton's forward interpolation formula.
5. To find the missing data using the Newton's backward interpolation formula.
6. To interpolate y using the Lagrange's method.
7. To find the derivative at initial point by Newton's forward formula.
8. To determine the numerical values of the derivative of a function at an initial point by Newton's backward formula.
9. To determine the maxima and minima of a function.
10. To find numerical solutions to definite integrals.

**Books for Study:**

1. Sastry, S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall of India Private limited, New Delhi, 2019.
2. Balagurusamy E, *Object-Oriented Programming with C++*, Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

**Books for Reference:**

1. Dr. Venkataraman M.K., *Numerical Methods in Science and Engineering*, The National Publishing Company, Chennai, 2013.
2. Veerarajan, T and Ramachandran, T, *Theory and problems in numerical methods with programs in C and C++*, Tata McGraw Hill Publishing Company Limited, New Delhi, 2004.

**Teaching Learning Methods:**

Lecture Method, ICT, Hands-on -session

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Apply the underlying concepts of object oriented programming to compute solutions to algebraic and transcendental equations	K3
CO2	Use function prototyping and function overloading to find solutions based on interpolation methods	K3
CO3	Write programs for finding the numerical values of the derivative of a function	K3
CO4	Construct programs determine the maxima and minima of a function	K3
CO5	Develop programs to find numerical solutions to definite integrals	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2	2	2		3			19
CO2	3	3			2	2	2	2	2		3			19
CO3	3	3			2	2	2	2	2		3			19
CO4	3	3			2	2	2	2	2		3			19
CO5	3	3			2	2	2	2	2		3			19
Grand Total of Cos with POs & PSOs														95
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{95}{40}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	COs of Numerical Methods using C++ Lab are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR

DEPARTMENT OF MATHEMATICS

Operations Research

(For those who join from June 2022 onwards)

Class	: B.Sc. Mathematics	Part	: III/Core-10
Semester	: V	Hours	: 90
Course Code	: 22UMAD05	Credits	: 5

**Objective**

This course aids the learners to gain knowledge on applying optimization techniques to solve the problems.

**Course Outline:**

**Unit 1 Introduction to Operations Research**

Over view of operations research – definition of L.P.P – mathematical formulation – graphical solution – general linear programming problems – canonical and standard forms – simplex method – properties of solutions (18 hours)

**Unit 2 Methods of Solving LPP**

Artificial variables – Big-M method- algorithm of Penalty method – two-phasesimplex method and its algorithm – degeneracy and cycling of a linear programming problem – duality in linear programming (18 hours)

**Unit 3 Game Theory**

Game and strategies – two-person zero sum games – maximin and minimax principle– games without saddle points – mixed strategies – graphical solution – dominance property – solution using L.P.P (18 hours)

**Unit 4 Sequencing & Replacement**

Sequencing problems – problems with n jobs and two machines – n jobs with three machines – replacement problems in manufacturing sectors (18 hours)

**Unit 5 Networking**

Network diagram representation – critical path method – time charts and resource levelling –Project Evaluation and Review Technique (PERT) (18 hours)

**Book for Study**

Kanthi Swarup, Gupta P.K., Man Mohan, *Operations Research*, Sultan Chand Sons, Educational Publishers, New Delhi, 2019.

Unit 1:	Chapter 1	Sections	1.1-1.11
	Chapter 2	Sections	2.1-2.4
	Chapter 3	Sections	3.1-3.5
Unit 2:	Chapter 4	Sections	4.1-4.5
	Chapter 5	Sections	5.1-5.4,5.7
Unit 3:	Chapter 17	Sections	17.1-17.7,17.9
Unit 4:	Chapter 12	Sections	12.1-12.4
	Chapter 18	Sections	18.1-18.3
Unit 5 :	Chapter 25	Sections	25.1-25.7

**Books for Reference:**

1. Kalavathy S., *Operations Research*, Vikas Publishing House Private Limited, New Delhi, 2019.
2. Panner Selvam R., *Operations Research*, Prentice Hall of India Private Limited, New Delhi, 2019.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Summarize the concepts of linear programming and apply graphical and simplex method to find the optimal solutions to LPP	K3
CO2	Employ the suitable methods of solving linear programming Problems	K3
CO3	Apply various techniques of game to find optimal strategies	K3
CO4	Solve the problems of replacements and sequencing	K3
CO5	Make use of algorithms to find the best solution to the Network problems	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3		3	2	3	2		3	2	3	2	2	28
CO2	3	3		2	2	3	2		3	3	3	2	2	28
CO3	3	3		2	2	3	2		3	2	3	2	2	27
CO4	3	3		2	2	3	2		3	2	3	2	2	27
CO5	3	3		2	2	3	2		3	2	3	2	2	27
Grand Total of COs with POs & PSOs														137
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{137}{55}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.5
Observation	COs of Operations Research are strongly correlated with POs & PSOs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR**  
**DEPARTMENT OF MATHEMATICS**  
**Number Theory**  
(For those who join from June 2022 onwards)

**Class** : III.B.Sc. Mathematics  
**Semester** : V  
**Course Code** : 22UMAE15 (A)

**Part** : III/ Core Elective-1  
**Hours** : 60  
**Credits**: 3

**Objective:**

This course facilitates the learners to comprehend the underlying concepts and applications of theory of numbers.

**Course Outline:**

**Unit 1: Natural numbers :**

Peano's axioms – principle of mathematical induction – addition and multiplication in natural numbers – order relation – Trichotomy law – principle of well ordering (12 hours)

**Unit 2: Integers :**

Addition and multiplication - positive and negative integers – Trichotomy law – absolute value (12 hours)

**Unit 3: Rational numbers :**

Addition and multiplication – Archimedean property – Trichotomy law – real numbers – axioms – subtraction – cancellation laws – Archimedean property (12 hours)

**Unit 4: Congruences :**

Congruences – Chinese remainder theorem – Euler's function – problems (12 hours)

**Unit 5: Theorems of Fermat and Euler :**

Fermat's theorem – Euler's theorem – Wilson's theorem – Lagrange's theorem – Applications (12 hours)

**Books for Study:**

1. Aggarwal, R.S., *Text Book on Set Theory and Number System*, S.Chand and Company, New Delhi.

Unit 1: Chapter 1

Unit 2: Chapter 2

Unit 3: Chapter 3 and 4

2. Arumugam, S. and Issac, *Set Theory, Number Systems and Theory of Equations*, New Gamma Publishing House, 1999.

Unit 4: Chapter 3 Sections: 3.1-3.4

Unit 5: Chapter 3 Section: 3.5



**Books for Reference:**

- 1.Kanna, M.L., *Number System*, 3<sup>rd</sup> Edition, Sri Prakashanath and Co Publishers, Meerut, 1981
- 2.Singal, M.K., Asha Rani, *Sets and Numbers*, II Edition, R.Chand and Co Publishers, New Delhi, 1976

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Illustrate Peano's axioms and related principles	K2
CO2	Discuss Trichotomy law of integers	K2
CO3	Explain the implications of Archimedean property of rational and real numbers	K2
CO4	Solve problems based on congruences	K3
CO5	Apply theorems to find solutions to the problems	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course outcome with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	3	3	3				3	2	3	3	2	28
CO2	3	3	3	3	3				3	2	3	3	2	28
CO3	3	3	3	3	3				3	2	3	3	2	28
CO4	3	3	3	3	3				3	3	3	2	2	28
CO5	3	3	3	3	3				3	3	3	2	2	28
Grand Total of COs with POs & PSOs														140
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{120}{50}$														2.8

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.5
Observation	COs of Number Theory are strongly correlated with POs & PSOs		

Class : III B.Sc. Mathematics

Semester : V

Course Code : 22UMAE15 (B)

Part : III/Core Elective-1

Hours : 60

Credits : 3

**Objective :**

This course enables the learners to gain profound knowledge on the fundamentals of Topology.

**Course Outline:**

**Unit 1: Elements of Set Theory :**

Relation and mappings – types of relations – equivalence classes – partitions – partial order relation – well ordered set – types of functions – inverse functions – composite functions (12 hours)

**Unit 2: Topological Spaces :**

Introduction to topology – definition and examples – various types of topology – intersection and union of topologies (12 hours)

**Unit 3: Basis for a topology :**

Characterization of topological spaces in terms of open and closed sets – basis for a topology (12 hours)

**Unit 4: Continuity :**

Continuity – criterion for continuous functions in terms of open and closed sets – open and closed mappings – homeomorphisms (12 hours)

**Unit 5: Connectedness :**

Connectedness – Separated sets – properties of separated sets – connected and disconnected sets (12 hours)

**Books for Study**

1. Arumugam S., Thangapandi Issac A., *Set Theory, Number Systems and Theory of Equations*, New Gamma Publishing House, Palayamkottai, 2000.

Unit 1 : Chapter 1 & Chapter 2

2. Kanna, M.L., *Topology*, Jai Prakashnath and Co., Meerut, 1998.

Unit 2 : Chapter 3 Sections 1 - 10

Unit 3 : Chapter 3 Sections 11 - 16

Unit 4 : Chapter 5 Sections 1, 2, 4

Unit 5 : Chapter 6 Sections 1-3

**Books for Reference:**

1. Shanthi Narayan, *General Topology*, S.Chand and Co, New Delhi, 1989
2. Chandrasekhra Rao, K, *General Topology*, S.Viswanathan, Chennai, 1986

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehend the concepts of relation and mappings	K2
CO2	Discuss the concepts of topological spaces	K2
CO3	Examine the characterizations of topological spaces	K4
CO4	Infer the nature of continuity of the functions	K4
CO5	Analyze the concepts of connectedness and its properties.	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

#### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2		2	3	22
CO2	3	3			2	2	2		3	2		3	3	23
CO3	3	3			2	2	2		3	2		2	3	22
CO4	3	3			2	2	2		3	2	3	2	2	24
CO5	3	3			2	2	2		3	2		2	3	22
Grand Total of COs with POs & PSOs														113
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{113}{46}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.5
Observation	COs of Elements of Topology are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625 514

DEPARTMENT OF MATHEMATICS

Internship

(For those who join from June 2022 onwards)

**Class : III B.Sc. Mathematics**

**Semester : V**

**Course Code : 22UINT15**

**Part : V**

**Hours : 30**

**Credits : 1**

**Objective:**

This course provides platform for the learners to get exposed to a new kind of learning environment for gaining significant experience on working with mathematical applications and for acquiring the skills of employability

**Outline**

- The students shall undertake their internship from IV semester holidays and must submit the report and attendance certificate before the external examinations of V semester.
- The students must periodically report their progress and status to their respective Staff-Incharge / supervisor.
- The students must complete their internship of 25 days by undertaking anyone of the following ways
  - The students shall work as intern in any of the related forums of their feasibility such as company, firms, NGO etc.
  - The students shall participate in the internship programs offered by other Institutions / Colleges / Universities.
  - The students shall work under faculty of other colleges and acquire exposure to any of the topics in mathematics.

**Evaluation :**

**Internal - 50 marks**

Attendance and Progress Report

**External – 50 marks**

Final Report & Viva-Voce

**Total – 100 marks**

## Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Articulate their acquired knowledge in different fields of study	K3
CO2	Acquire and employ the skills of communication, problem solving, critical thinking in the context of employability	K3
CO3	Correlate the theoretical conceptualization to practical utility	K4
CO4	Work in projects by experimenting, exploring, integrating and appreciating the implication of mathematical concepts	K4
CO5	Develop and apply the skill of documentation of their works	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2	2	2	2	3	2	3	3	2	2	2	3	31
CO2	3	2	2	2	2	3	2	3	3	2	2	2	3	31
CO3	3	2	2	2	2	3	2	3	3	2	2	2	3	31
CO4	3	2	2	2	2	3	2	3	3	2	2	2	3	31
CO5	3	2	2	2	2	3	2	3	3	2	2	2	3	31
Grand Total of COs with POs & PSOs														155
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{155}{65}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	COs of Internship are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625 514

DEPARTMENT OF MATHEMATICS

Statistical Methods in Social Sciences

(For those who joined in June 2022 onwards)

Class : III UG Part : SLC - Optional  
Semester : V Credits: 3  
Course Code : 22UMASL5

**Objective:**

This course enables the learners to apply statistical methods to the problems of real life.

**Course Outline:**

- Unit 1:** Arithmetic mean – measures of dispersion – standard deviation – mean square deviation – coefficient of variation – variance
- Unit 2:** Correlation coefficient for two variables – rank correlation
- Unit 3:** Sampling – different kinds of samples
- Unit 4:** Small samples – t–distribution – F-distribution
- Unit 5:** Analysis of variance – one criterion and two criterion of classifications

**Book for Study**

Arumugam, S., *Statistics*, New Gamma Publishing House, Palayamkottai, 2004.

- Unit 1 : Chapter 2 Sections: 2.1, 3.1  
Unit 2 : Chapter 6 Sections: 6.0 – 6.2  
Unit 3 : Chapter 14 Section: 14.1  
Unit 4 : Chapter 15 Section: 15.1  
Unit 5 : Chapter 17 Sections: 17.1, 17.2

**Books for Reference:**

1. Agarwal B.L., *Basic Statistics*, Wiley Eastern Limited, New Delhi, 2004.
2. Gupta S.P., *Statistical Methods*, Sultan Chand and Sons, New Delhi, 2006.

**Teaching Learning Methods:**

- Lecture Method, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Calculate mean and standard deviation for the given data	K3
CO2	Find the correlation coefficient using different methods	K3
CO3	Explain sampling and its types	K2
CO4	Apply parametric and non-parametric tests	K3
CO5	Employ ANOVA and make inferences	K3

K1 =Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2		2		2			3		3		2	17
CO2	3	2		2		2			3		3		2	17
CO3	3	2		2		2			2		2		2	15
CO4	3	2		2		2			3		3		2	17
CO5	3	2		2		2			3		3		2	17
Grand Total of COs with POs & PSOs														83
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{83}{35}$														2.37

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.37
Observation	COs of Statistical methods in Social Sciences are strongly correlated with POs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Linear Algebra

(For those who join from June 2022 onwards)

Class : III B.Sc. Mathematics

Part : III/Core 11

Semester : VI

Hours : 90

Course Code : 22UMAD16

Credits : 5

**Objective :**

This course makes the learners acquire intense knowledge on Vector space and Matrix theory

**Course Outline:**

**Unit 1: Vector Spaces**

Definition and examples – subspaces – linear transformations – fundamental theorem of homomorphism – span of a set. **(18 hours)**

**Unit 2: Linear independence**

Basis and dimension – rank and nullity – matrix of a linear transformation – maximal linearly independent set – minimal generating set. **(18 hours)**

**Unit 3: Inner product spaces**

Definition and examples – Schwartz inequality – orthogonality – Gram-Schmidt orthogonalization process – orthogonal complement. **(18 hours)**

**Unit 4: Theory of matrices**

Algebra of matrices – types of matrices – inverse of a matrix canonical form – similarity of matrices – rank – simultaneous linear equations. **(18 hours)**

**Unit 5: Eigen Values**

Characteristic equation of a matrix – Cayley-Hamilton theorem – eigen values and eigenvectors. **(18 hours)**

**Book for Study**

Arumugam S., Thangapandi Issac A., *Modern Algebra*, SCITECH Publications(India) Pvt Ltd., Chennai, 2018.

Unit 1 : Chapter 5 Sections: 5.0 – 5.4

Unit 2 : Chapter 5 Sections: 5.5 – 5.8

Unit 3 : Chapter 6 Sections: 6.0 – 6.3

Unit 4 : Chapter 7 Sections: 7.0 – 7.3, 7.5, 7.6

Unit 5 : Chapter 7 Sections: 7.7, 7.8

**Books for Reference:**

1. Surjeet Singh, Qazi Zameerudin, *Modern Algebra*, Vikas Publishing House Private Limited, New Delhi, 2012.

2. Vasishtha A.R., *Modern Algebra*, Krishna Prakasham Mandir, Meerut, 2013.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion



### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the concept of vector spaces and linear transformations	K3
CO2	Apply the concept of linear independence and basis	K3
CO3	Describe the concept of inner product spaces and apply Gram-Schmidt orthogonalization process	K3
CO4	Justify the theoretical conceptualization of matrices	K4
CO5	Compute Eigen values and Eigen vectors and analyze their properties	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2	2	2	2	23
CO2	3	3			2	2	2		3	2	2	2	2	23
CO3	3	3			2	2	2		3	3	2	2	2	24
CO4	3	3			2	2	2		3	3	2	2	2	24
CO5	3	3			2	2	2		3	2	2	2	2	23
Grand Total of COs with POs & PSOs														117
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{117}{50}$														2.3

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.3
Observation	COs of Linear Algebra are strongly correlated with POs & PSOs		

DEPARTMENT OF MATHEMATICS

Complex Analysis

(For those who join from June 2022 onwards)

Class : III B.Sc. Mathematics

Part : III/Core 12

Semester : VI

Hours : 90

Subject Code : 22UMAD26

Credits : 5

**Objective:**

This course provides a platform for the learners for acquiring intense knowledge of complex numbers and their relationships with respect to functions, limits, derivatives and integrals.

**Course Outline:**

**Unit 1: Analytic Functions :**

Functions of a complex variable – limits – continuous functions – differentiability – Cauchy Riemann equations – analytic functions – harmonic functions – conformal mapping **(18 hours)**

**Unit 2: Bilinear Transformations and Power Series :**

Elementary transformations – bilinear transformations – cross ratio – power series – sequences and series – sequences and series of functions – elementary functions **(18 hours)**

**Unit 3: Definite Integrals :**

Definite integrals – Cauchy's theorem – Cauchy's theorem for simply and multiply connected regions – Cauchy integral formula – maximum modulus theorem – higher derivatives **(18 hours)**

**Unit 4: Analytic Functions as Power Series :**

Series expansions – Taylor's series – Laurent's series – zeros of an analytic function – singularities – meromorphic function **(18 hours)**

**Unit 5: Calculus of Residues :**

Calculus of residues – residues – Cauchy's residue theorem – argument theorem – Rouché's theorem – fundamental theorem of algebra – evaluation of definite integrals **(18 hours)**

**Book for Study:**

Arumugam S., Thangapand Issac A., Somasundaram A., *Complex Analysis*, SCITECH Publications (India)Pvt Ltd., Chennai, 2019.

Unit 1 : Chapter 2                      Sections : 2.0 – 2.9

Unit 2 : Chapter 3                      Sections : 3.0 – 3.3

Chapter 4                                Sections : 4.0 – 4.4

Unit 3 : Chapter 6                      Sections : 6.0 – 6.4

Unit 4 : Chapter 7                      Sections : 7.0 – 7.4

Unit 5 : Chapter 8                      Sections : 8.0 – 8.3

**Books for Reference:**

1. Karunakaran V., *Complex Analysis*, II edition, Narosa Publishing House Pvt. Ltd., New Delhi, 2006.
2. Lars V Ahlfors, *Complex Analysis*, McGraw Hill Book Company, Singapore, 2014

Reprint.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Recall the concept of limits and continuity and apply the CR equations to determine the nature of complex functions	K3
CO2	Apply different types of transformations and make inferences on the geometrical properties	K3
CO3	Find the integrals and deduce the higher derivatives of complex functions	K3
CO4	Categorize the singularities by analyzing the series expansions	K4
CO5	Calculate the residues and estimate the values of integrals using contour integration	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2	2	2	2	23
CO2	3	3			2	2	2		3	2	2	2	2	23
CO3	3	3			2	2	2		3	3	2	2	2	24
CO4	3	3			2	2	2		3	3	2	2	2	24
CO5	3	3			2	2	2		3	2	2	2	2	23
Grand Total of COs with POs & PSOs														117
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{117}{50}$														2.3

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.3
Observation	COs of Complex Analysis are strongly correlated with POs & PSOs		

Class : III B.Sc. Mathematics

Part : III Core 13

Semester : VI

Hours :90

Subject Code : 22UMAD36

Credits: 5

**Objective :**

This course makes the learners acquire intense knowledge of the fundamental concepts of Graph and its properties

**Unit 1: Graphs and Subgraphs**

Introduction – application of Graphs – finite and infinite graphs – incidence and degrees – isolated vertex-pendant vertex – null graph-isomorphism – sub graphs – walks, paths and circuits **(18 hours)**

**Unit 2: Connected graphs**

Connected graphs – disconnected graphs – components – Euler graphs – Hamiltonian paths – Hamiltonian circuits – the travelling salesman problem **(18 hours)**

**Unit 3: Trees**

Trees – definition and examples – some properties of trees – pendant vertices in a tree – distance and centers in a tree – Cut sets – definition and examples – fundamental cut sets **(18 hours)**

**Unit 4: Planar graphs**

Planar graphs – Kuratowski's two graphs – different representation of planar graphs – Euler's graphs – plane representation and connectivity – detection of planarity **(18 hours)**

**Unit 5: Coloring and Covering**

Coloring and Covering-Chromatic number- Chromatic partitioning- Chromatic polynomial - Matching-Coverings. **(18 hours)**

**Book for Study**

Narsingh Deo "*Graph Theory with applications to Engineering and Computer Science*" PHI learning private limited, New Delhi, 2018.

Unit 1 : Chapter 1	Sections: 1.1 – 1.5
Chapter 2	Sections: 2.1– 2.4
Unit 2 : Chapter 2	Sections: 2.5 – 2.10
Unit 3 : Chapter 3	Sections: 3.1– 3.4
Chapter 4	Sections: 4.1 – 4.4
Unit 4 : Chapter 5	Sections: 5.1 – 5.5
Unit 5 : Chapter 8	Sections: 8.1 – 8.5

**Books for Reference:**

1. Frank Harary., *Graph Theory*, Narosa Publishing House, Madras, 2011.
2. Arumugam S., Ramachandran S., *Invitation to Graph Theory*. SCITECH Publications (India) Pvt Ltd., Chennai, 2014.

**Teaching Learning Methods:**

- Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Recall the basics of Graph and its properties	K2
CO2	Discuss connected graphs and apply in solving travelling salesman problem	K3
CO3	Use the concepts of tree and its properties in solving problems.	K3
CO4	Examine the nature of planar graphs and planarity	K4
CO5	Make inferences on colouring and coverings	K4

**K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create**

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2		3	2	3	2	2	24
CO2	3	3			2	2	2		3	2	2	3	2	24
CO3	3	3			2	2	2		3	2	2	2	2	23
CO4	3	3			2	2	2		3	3	2	3	3	26
CO5	3	3			2	2	2		3	3	2	3	3	26
Grand Total of COs with POs & PSOs														123
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{123}{50}$														2.5

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.5
Observation	COs of Graph Theory are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR

DEPARTMENT OF MATHEMATICS

Industrial Optimization Techniques

(For those who join from June 2022 onwards)

Class	: B.Sc. Mathematics	Part	: III/Core-14
Semester	: VI	Hours	: 90
Course Code	: 22UMAD46	Credits	: 5

**Objective**

This course enables the learners to gain knowledge and the skill of applying optimization techniques to solve industrial oriented problems.

**Course Content:**

**Unit I: Transportation & Assignment Problems**

Transportation problems –methods of finding the feasible solution – optimum solution using MODI method - assignment problem - Hungarian Algorithm – traveling salesman problem  
**(18 Hours)**

**Unit II: Decision Analysis**

Introduction to decision making- decision-making process-decision-making environment- decision-making under uncertainty  
**(18 Hours)**

**Unit III: Inventory Models**

Inventory and its types, objectives and associated costs – inventory control problem – economic order quantity model– deterministic inventory problems with and without shortages - simulation of inventory production problems  
**(18 Hours)**

**Unit IV: Queuing Theory**

Queue– characteristics – Poisson and Exponential distributions – transient and steady state – Poisson process – finite and infinite queues – M/M/I and M/M/C models - simulation of queuing systems  
**(18 Hours)**

**Unit V Simulation**

Simulation – process of simulation – simulation models – generation of random numbers – Monte – Carlo simulation – simulation of inventory problems – simulation of queuing systems  
**(18 Hours)**

**Book for Study**

Kantheni Swarup, Gupta P.K., Man Mohan, *Operations Research*, Sultan Chand Sons, Educational Publishers, New Delhi, 2019.

Unit 1:	Chapter 10	Sections: 10.1-10.13
	Chapter 11	Sections: 11.1-11.3,11.7
Unit 2:	Chapter 16	Sections: 16.1-16.5
Unit 3 :	Chapter 19	Sections: 19.1 – 19.11
Unit 4 :	Chapter 21	Sections: 21.1 – 21.9 (up to model V)
Unit 5 :	Chapter 22	Sections: 22.1 – 22.9

**Books for Reference:**

1. Kalavathy S., *Operations Research*, Vikas Publishing House Private Limited, New Delhi, 2019.
2. Panner Selvam R., *Operations Research*, Prentice Hall of India Private Limited, New Delhi, 2019.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Apply different methods to solve transportation problems and find solutions to assignment and travelling salesman problems	K3
CO2	Solve the decision-making problems under uncertain environments	K3
CO3	Determining optimal order quantity and time to various types inventory models	K3
CO4	Find optimal solutions to queuing based problems	K3
CO5	Explain and use the concept of simulation to inventory and queuing Systems	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3		3	2	3	2		3	2	3	2	2	28
CO2	3	3		3	2	3	2		3	2	3	2	2	28
CO3	3	3		3	2	3	2		3	3	3	2	2	29
CO4	3	3		2	2	3	2		3	2	3	2	2	27
CO5	2	3		3	2	3	2		3	2	3	2	2	27
Grand Total of COs with POs & PSOs														139
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{139}{55}$														2.5

Strong – 3, Medium – 2, Low – 1

<b>Mapping Scale</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Relation</b>	<b>0.01-1.0</b>	<b>1.01-2.0</b>	<b>2.1-3</b>
<b>Quality</b>	<b>Low</b>	<b>Medium</b>	<b>Strong</b>
<b>Mean Value of Cos with POs &amp; PSOs</b>			<b>2.5</b>
<b>Observation</b>	<b>COs of Industrial Optimization Techniques are strongly correlated with POs &amp; PSOs</b>		



ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Java Programming

(For those who join in June 2022 onwards)

Class : III B.Sc. Mathematics

Part : III /Core Elective 2

Semester : VI

Hours : 30

Course Code : 22UMAE26 (A)

Credits : 2

**Objective:**

This course intends to make the learners gain knowledge on Java Programming Language.

**Course Outline:**

**Unit 1: Elements of Java**

Java constants – variables - datatypes – Declaration of variables – Java Operators –  
Mathematical functions (6 hours)

**Unit 2: Decision making and Branching**

Simple if statements – The if...else statement – Nesting of if...else statements –  
The else if Ladder – The Switch statements (6 hours)

**Unit 3: Decisionmaking and Looping**

The while statement - The do statement - the for statements – Labelled Loops  
(6 hours)

**Unit 4: Classes, objects and Methods**

Accessing class members -constructors – methods overloading – static members.  
(6 hours)

**Unit 5: Arrays**

One dimensional array -creating an array – two dimensional arrays - Strings  
(6 hours)

**Book for Study:**

Balagurusamy E., *Programming with Java A Primer*, Tata McGraw-Hill Publishing  
Company Limited, New Delhi, 2012.

Unit 1 : Chapter 4	Sections: 4.1 – 4.6
Chapter 5	Sections: 5.1-5.9 , 5.15
Unit 2 : Chapter 6	Sections: 6.1-6.7
Unit 3 : Chapter 7	Sections: 7.1-7.6
Unit 4 : Chapter 8	Sections: 8.1 – 8.9
Unit 5 : Chapter 9	Sections: 9.1 – 9.5

**Books for Reference:**

1. Herbert Schildt., *The Complete Reference: Java J2SE*, Tata McGraw-Hill Publishers Private Limited, New Delhi, 2011.
2. John Hubbard R., *Programming with Java*, McGraw-Hill International Editions, Schaum's Outline Series, Madras, 2012.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Apply the basics of Java language in programming	K3
CO2	Employ different branching statements in programming	K3
CO3	Develop Java programming by using looping statements for recursion.	K3
CO4	Construct classes and objects in programming to determine solutions	K3
CO5	Write programs using the concept of arrays	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2		2	2	3		3			18
CO2	3	3			2	2	2	2	3	2	3		2	24
CO3	3	3			2	2	2	2	3	2	3		2	24
CO4	3	3			2		2	2	3		3			18
CO5	3	3			2	2	2	2	3	2	3		2	24
Grand Total of COs with POs & PSOs														108
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{108}{44}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.5
Observation	COs of Java Programming are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Java Programming Lab

(For those who join from June 2022 onwards)

Class	: III B.Sc. Mathematics	Part	: III /Core Elective -2
Semester	: VI	Hours	: 30
Course Code	: 22UMAJ16 (A)	Credits:	1

**Objective :**

This course will develop the Java programming skills of the learners.

**Course Outline:**

**List of Programs**

Write a Java program

1. To find the largest number among the given three numbers.
2. To find the prime numbers from 3 to 300.
3. To find the perfect numbers from 5 to 500.
4. To determine  $nCr$  and  $nPr$  for the given values  $n$  and  $r$ .
5. To check whether a given number is Palindrome or not.
6. To find  $y(x)$  at any value of  $x$  using Newton's forward interpolation formula.
7. To sort the numbers using the concepts of arrays.
8. To determine the inverse the given two matrices.
9. To find the product the given two matrices.
10. To prepare the Pay clips by using class and objects.

**Book for Study:**

Balagurusamy E., *Programming with Java A Primer*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2012.

**Books for Reference:**

1. Herbert Schildt., *The Complete Reference: Java J2SE*, Tata McGraw-Hill Publishers Private Limited, New Delhi, 2011.
2. John Hubbard R., *Programming with Java*, McGraw-Hill International Editions, Schaum's Outline Series, Madras, 2012.

**Teaching Learning Methods:**

Lecture Method, ICT, Hands-on -session

## Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehend and apply the nuances of Java programming language	K3
CO2	Apply branching statements in developing programs	K3
CO3	Employ the concept of looping in Programming.	K3
CO4	Write programs using classes and objects	K3
CO5	Use arrays to handle matrix operations	K3

K1=Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 =Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2	2	2		3			19
CO2	3	3			2	2	2	2	2		3			19
CO3	3	3			2	2	2	2	2		3			19
CO4	3	3			2	2	2	2	2		3			19
CO5	3	3			2	2	2	2	2		3			19
Grand Total of COs with POs & PSOs														95
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{95}{40}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	COs of Java Programming Lab are strongly correlated with POs &PSOs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR**  
**DEPARTMENT OF MATHEMATICS**

**R Programming**

(For those who join from June 2022 onwards)

<b>Class</b>	<b>: B.Sc. Mathematics</b>	<b>Part</b>	<b>: III/Core Elective-2</b>
<b>Semester</b>	<b>: VI</b>	<b>Hours</b>	<b>: 30</b>
<b>Course Code</b>	<b>: 22UMAE26 (B)</b>	<b>Credits</b>	<b>: 2</b>

**Objective:**

This course aims in imparting R programming skills to the learners for effective data visualization and analysis.

**Course Outline:**

**Unit 1 Fundamentals of R**

Introduction to R programming - Installing R and R Studio - R Studio overview- working in the console - arithmetic operators -logical operators – functions **(6 Hours)**

**Unit 2 Data Structures in R**

Creating variables - numeric, character and logical data – vectors – data frames– factors sorting numeric, character, factor - vectors **(6 Hours)**

**Unit 3 Plotting in R**

Statistical graphs - Scatter Plots - Box Plots – Histograms – Bar plots – pie chart - ggplot2 package to visualize data – ggthemes for customization **(6 Hours)**

**Unit 4 Control Structures & Packages in R**

Conditional statements in R – loop statements - R packages - installing and loading packages - setting up your working directory - working with missing data **(6 Hours)**

**Unit 5 Statistical Analysis in R**

Descriptive statistics in R - measures of central tendency - measures of variability - skewness and kurtosis - summary functions –correlations – inferential statistics in R – parametric tests – non parametric tests **(6 Hours)**

**Books for Study**

Davies, Tilman M. *The book of R: A first course in programming and statistics*. No Starch Press, 2020.

Unit 1:	Chapter 1	Sections 1.1 – 1.4
Unit 2:	Chapter 2	Sections 2.1-2.3
	Chapter 3	Sections 3.1-3.4
Unit 3 :	Chapter 7	Sections 7.1-7.4
Unit 4 :	Chapter 10	Sections 10.1 – 10.3
Unit 5 :	Chapter 13	Sections 13.1 – 13.2
	Chapter 16	Sections 16.1-16.2

**Book for Reference**

1. Richard Hurley, *Data Science A Comprehensive Guide to Data Science, Data Analytics, Data Mining, Artificial Intelligence, Machine Learning, and Big Data*, Ationa Publications, 2020
2. Zumel, Nina, and Mount, John, *Practical Data Science with R*, Manning Publications, 2019.
3. Shah, Chirag, *A Hands-On Introduction to Data Science*, Cambridge University Press,

2020.

**Teaching Learning Methods:**

Lecture Method, ICT, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the fundamentals of R programming languages	K2
CO2	Comprehend the different data structures in R	K2
CO3	Apply different plot functions to visualize the data sets	K3
CO4	Use suitable conditional and loop statements in R programs and install necessary packages	K3
CO5	Employ respective statistical functions to the given data sets	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 =

**Create Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2		2	2	3		3			18
CO2	3	3			2	2	2	2	3	2	3		2	24
CO3	3	3			2	2	2	2	3	2	3		2	24
CO4	3	3			2		2	2	3		3			18
CO5	3	3			2	2	2	2	3	2	3		2	24
Grand Total of COs with POs & PSOs														108
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{108}{44}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.5
Observation	COs of R Programming are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR

DEPARTMENT OF MATHEMATICS

R Programming Lab

(For those who join from June 2022 onwards)

Class	: B.Sc. Mathematics	Part	: III/Core Elective Lab
Semester	: VI	Hours	: 30
Course Code	: 22UMAJ16 (B)	Credits	: 1

**Objective:**

This course enables the learners to acquire R programming skills.

**Course Outline:**

**List of Programs**

1. Write R programs for applying different operators to the given data sets.
2. Write R programs using the following Flow control statements.
  - a) if-else
  - b) for Loops
  - c) Nested for loops
  - d) while Loops
  - e) repeat Loops
  - f) next, break
3. Write R programs for representing the given data sets graphically using the following graphs with ggplot package.
  - a) Box Plot
  - b) Histograms
  - c) Scatter Plot
  - d) Line chart
  - e) Bar Chart
  - f) Heat maps
4. Write R programs for finding the following for a given data set.
  - i. measures of central tendency
  - ii. measures of variability
  - iii. skewness and kurtosis
  - iv. Corelation
  - v. Regression
5. Write R programs for applying the following tests for the given data sets.
  - i. parametric tests
  - ii. non-parametric test

**Book for Study**

Davies, Tilman M. *The book of R: A first course in programming and statistics*. No Starch Press, 2020.

### Books for Reference

1. Richard Hurley, *Data Science A Comprehensive Guide to Data Science, Data Analytics, Data Mining, Artificial Intelligence, Machine Learning, and Big Data*, Ationa Publications, 2020
2. Zumel, Nina, and Mount, John, *Practical Data Science with R*, Manning Publications, 2019.
3. Shah, Chirag, *A Hands-On Introduction to Data Science*, Cambridge University Press, 2020.

### Teaching Learning Methods:

Lecture Method, ICT, Hands-on -session

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehend and apply the operators of R programming language	K3
CO2	Use flow control statements in writing R programs	K3
CO3	Apply ggplot to visualize the data graphically	K3
CO4	Employ statistical functions to draw descriptive statistical measures to the given data sets	K3
CO5	Determine the inferential statistical measures to the given data sets	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2	2	2	2	2		3			19
CO2	3	3			2	2	2	2	2		3			19
CO3	3	3			2	2	2	2	2		3			19
CO4	3	3			2	2	2	2	2		3			19
CO5	3	3			2	2	2	2	2		3			19
Grand Total of COs with POs & PSOs														95
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{95}{40}$														2.4

### Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	COs of R Programming Lab are strongly correlated with POs & PSOs		



ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625 514

DEPARTMENT OF MATHEMATICS

Mathematical Methods in Business

(For those who join from June 2022 onwards)

Class : III UG

Semester : VI

Course Code : 22UMASL6

Part : SLC-Optional

Credits: 3

**Objective:**

This course intends to impart the knowledge of applying mathematical methods to solve business centered problems

**Course Outline:**

**Unit 1:** Roots – Square roots – Cube roots – Laws of indices – Surds – Law of Surds

**Unit 2:** Profit and Loss – Cost Price – Selling price – Percentage of profit and loss

**Unit 3:** Chain rule – Simple Proportion – Compound proportion – Direct and Indirect Proportion

**Unit 4:** Ratio and proportion – Product of extreme and means – Mean proportional

**Unit 5:** True Discount– Simple Interest – Present worth – Simple Interest on True Discount

**Book for Study**

Aggarwal, R.S., *Objective Arithmetic*, S.Chand & Company Ltd., New Delhi, 2015.

Unit 1 : Chapters 5 & 9

Unit 2 : Chapter 11

Unit 3 : Chapter 14

Unit 4 : Chapter 12

Unit 5 : Chapter 21

**Books for Reference:**

1. Ashish Aggarwal, *Quick Arithmetic*, S.Chand & Company Ltd., New Delhi, 2011.
2. David Novak, *Basic Mathematics*, D.C. Heath and Company, 2011.
3. Sharma J.N., Gupta R.K., *Mathematical Methods*, Krishna Prakasam Mandir, Meerut, 2010.

**Teaching Learning Methods:**

- Lecture Method, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Find the roots of the equation	K3
CO2	Solve the problems based on percentage	K3
CO3	Calculate solutions to the problems of direct & indirect proportion	K3
CO4	Resolve the problems based on ratio and proportion	K3
CO5	Compute solutions to the problems of simple interest & discount	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2		2		2			3		3		2	17
CO2	3	2		2		2			3		3		2	17
CO3	3	2		2		2			2		2		2	15
CO4	3	2		2		2			3		3		2	17
CO5	3	2		2		2			3		3		2	17
Grand Total of COs with POs & PSOs														83
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{83}{35}$														2.37

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.37
Observation	COs of Mathematical Methods in Business are strongly correlated with POs		

**DEPARTMENT OF MATHEMATICS**  
**ARUL ANANDAR COLLEGE (AUTONOMOUS)**  
**M.Sc. MATHEMATICS**  
**CBCS & OBE PATTERN (From 2022 – 2023 onwards)**

Nature of the Course	Course Code	Course Title	Hr	Cr
<b>FIRST YEAR – FIRST SEMESTER</b>				
<b>Core</b>	22PMAC11	<b>Core – 1</b> Modern Algebra	06	05
	22PMAC21	<b>Core – 2</b> Real Analysis	06	05
	22PMAC31	<b>Core – 3</b> Numerical Analysis	06	05
	22PMAC41	<b>Core – 4</b> Statistics	06	05
<b>Core Elective</b>	22PMAE11	<b>Core Elective – 1</b> Graph Theory / Cryptography	06	04
		<b>Total</b>	<b>30</b>	<b>24</b>
<b>FIRST YEAR – SECOND SEMESTER</b>				
<b>Core</b>	22PMAC52	<b>Core – 5</b> Linear Algebra	06	05
	22PMAC62	<b>Core – 6</b> Measure and Integration	06	05
	22PMAC72	<b>Core – 7</b> Differential Equations	06	05
<b>Core Elective</b>	22PMAE22	<b>Core Elective – 2</b> Differential Geometry / Research Methodology	06	04
<b>Non - Major Elective</b>	22PMAN12	<b>Non-Major Elective</b> Numerical & Statistical Methods	04	04
<b>Life Skills</b>	22PLFS12	Life Skills	02+2*	02
		MOOC / SWAYAM		02**
		<b>Total</b>	<b>30</b>	<b>25</b>
<b>SECOND YEAR – THIRD SEMESTER</b>				
<b>Core</b>	22PMAC83	<b>Core – 8</b> Topology	06	05
	22PMAC93	<b>Core – 9</b> Classical Mechanics	06	05
	22PMAD03	<b>Core – 10</b> Complex Analysis	06	05
	22PMAD13	<b>Core – 11</b> Operations Research	06	05
<b>Core Elective</b>	22PMAE33	<b>Core Elective – 3</b> Mathematical Modeling / Calculus of Variations	06	04
		MOOC / SWAYAM		02**
		<b>Total</b>	<b>30</b>	<b>24</b>
<b>SECOND YEAR – FOURTH SEMESTER</b>				
<b>Core</b>	22PMAD24	<b>Core – 12</b> Functional Analysis	06	05
	22PMAD34	<b>Core – 13</b> Fuzzy Sets and Applications	06	05
	22PMAD44	<b>Core – 14</b> Project	12	05
<b>Core Elective</b>	22PMAE44	<b>Core Elective – 4</b> Automata Theory / Fluid Dynamics	06	04
		<b>Total</b>	<b>30</b>	<b>19</b>

Semester	I	II	III	IV	Total
<b>Credits</b>	24	25	24	19	92

\* represents practical outside the class hour

\*\* Extra credit course

### **Self-Learning Courses 2**

The students can undertake any online courses offered by SWAYAM during any of the semesters and can earn extra credit.

**Credit 2 per course**

**Maximum 4 credits**

Class : M.Sc. Mathematics

Part : Core-1

Semester : I

Hours : 90

Course Code : 22PMAC11

Credits : 5

**Objective:**

This course will enable the learners acquire intense knowledge and analyze the concepts of groups, rings and fields

**Course Content:**

**Unit 1:** Another counting principle – conjugate – conjugate class – normalizer — center of group- Cauchy theorem- partition **(18 Hours)**

**Unit 2:** Sylow's theorem – 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> proofs – p-Sylow subgroup- direct products of finite abelian groups **(18 hours)**

**Unit 3:** Euclidean ring – principle ideal ring – greatest common divisor- prime element – unique factorization theorem- a particular Euclidean ring– Gaussian integers– Fermat theorem **(18 hours)**

**Unit 4:** Polynomial rings – division algorithm – irreducible polynomials - polynomials over the rational field– Gauss Lemma- Eisenstein criterion **(18 hours)**

**Unit 5:** Fields – extension fields – algebraic extension – roots of polynomials remainder theorem – splitting field – isomorphism between fields **(18 hours)**

**Book for Study:**

Herstein, I.N., *Topics in Algebra*, John Wiley and Sons Pvt. Ltd., Singapore, 2016.

Unit 1:	Chapter 2	Section	2.11
Unit 2:	Chapter 2	Sections	2.12 - 2.14
Unit 3:	Chapter 3	Sections	3.7 - 3.8
Unit 4:	Chapter 3	Sections	3.9 - 3.10
Unit 5:	Chapter 5	Sections	5.1 - 5.3

**Books for References:**

1. Vijay Khanna., *A course in Abstract Algebra*, V Edition, 2018.
2. Serge Lang, *Algebra*, Third Edition, Springer Graduate Texts in Mathematics, New York, 2002

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Illustrate the concepts of counting principle and explain the characterization of p-Sylow groups	K2
CO2	Infer the implications of Sylow's theorem to finite abelian groups	K4
CO3	Examine the theoretical conceptualization of Euclidean rings	K4

<b>CO4</b>	Draw inferences on the polynomial rings	<b>K4</b>
<b>CO5</b>	Summarize the algebraic extension of field, splitting field and the isomorphism between fields with suitable justifications	<b>K5</b>

**K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create**

#### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
<b>CO1</b>	3	2			2				3	2	2	3	3	20
<b>CO2</b>	3	3			2				3	2	3	3	2	21
<b>CO3</b>	3	2			2				3	2	3	3	3	21
<b>CO4</b>	3	3			2				3	2	3	3	2	21
<b>CO5</b>	3	2			2				3	2	2	3	3	20
<b>Grand Total of Cos with POs &amp; PSOs</b>														103
<b>Mean Value of Cos with POs &amp; PSOs = <math>\frac{\text{Grand Total of Cos with Pos \&amp; PSOs}}{\text{Number of Cos relating with POs \&amp; PSOs}} = \frac{103}{40}</math></b>														2.58

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.58
Observation	COs of Modern Algebra are strongly correlated with POs		

<b>Class</b>	<b>: M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core-2</b>
<b>Semester</b>	<b>: I</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAC21</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course intends to facilitate the learners analyze the concepts of metric spaces, limits and continuity of functions.

**Course Content:**

**Unit 1:** Finite, countable and uncountable sets – metric spaces – compact sets –Heine Borel theorem-Weierstrass theorem- perfect sets –Cantor set- connected sets **(18 hours)**

**Unit 2:** Limits of functions – continuous function – continuity and compactness – continuity and connectedness – discontinuities – monotonic functions – infinite limits and limits at infinity **(18 hours)**

**Unit 3:** Derivative of a real function – mean value theorems – generalized mean value theorem - continuity of derivatives – L’Hospital’s Rule – derivatives of higher order – Taylor’s theorem- differentiation of vector valued functions. **(18 hours)**

**Unit 4:** Riemann -Stieltjes Integral- definition and existence of the integral-properties – integration and differentiation – integration of vector-valued functions – rectifiable curves **(18 hours)**

**Unit 5:** Sequences and series of functions-uniform convergence – uniform convergence and continuity – uniform convergence and integration – uniform convergence and differentiation - Equicontinuous families of functions – Stone-Weierstrass theorem. **(18 hours)**

**Book for Study:**

Walter Rudin, *Principles of Mathematical Analysis*, McGraw-Hill International Editions, New Delhi, Third Edition,2017

Unit 1: Chapter 2 Sections 2.1-2.47

Unit 2: Chapter 4 Sections 4.1-4.34

Unit 3: Chapter 5 Sections 5.1-5.19

Unit 4: Chapter 6 Sections 6.1-6.27

Unit 5: Chapter 7 Sections 7.1-7.33

**Books for References:**

1. Tom M. Apostol, *Mathematical Analysis*, Addison-Wesley Publishing Company, London, 2010.
2. Richard R. Goldberg, *Methods of Real Analysis*, Oxford & IBH Publishing Company, New Delhi, 1970.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the concepts and theorems associated with compactness and connectedness	K2
CO2	Analyze the characterizations of the functions and find its limit	K4
CO3	Examines the theorems related to the derivatives	K4
CO4	Draw inferences on Riemann -Stieltjes integrals, properties and related concepts	K4
CO5	Infer the implications of uniform convergence	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2			2				3	2	2	3	3	20
CO2	3	3			2				3	3	3	3	2	22
CO3	3	3			2				3	3	3	3	2	22
CO4	3	3			2				3	3	3	3	2	22
CO5	3	3			2				3	3	3	2	2	21
Grand Total of Cos with POs & PSOs														107
<b>Mean Value of Cos with POs &amp; PSOs</b> = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{107}{40}$														2.68

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.68
Observation	Cos of Real Analysis are strongly correlated with POs		



**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**

**Numerical Analysis**

(For those who join from June 2022 onwards)

<b>Class</b>	<b>: M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core-3</b>
<b>Semester</b>	<b>: I</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAC31</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course will make the learners apply the various numerical methods and analyze the nature of the numerical solutions.

**Course Content:**

- Unit 1:** Transcendental and polynomial equation – bisection method – secant and Regula – Falsi method – Newton– Raphson method – iteration methods based on second degree equation – Muller method – Chebyshev method – multi point iteration methods – system of non-linear equations – methods for complex roots  
**(18 hours)**
- Unit 2:** System of linear algebraic equations and eigen value problem – direct methods – iteration methods – Jacobi-iteration method, Gauss-Seidel iteration method  
**(18 hours)**
- Unit 3:** Interpolation and approximation: Hermite interpolation – piecewise and spline interpolation – bivariate interpolation  
**(18 hours)**
- Unit 4:** Numerical Differentiation and Numerical integration – extrapolation techniques – Gaussian quadrature – adaptive integration – multiple integrals – multiple integrals with variable limits  
**(18 hours)**
- Unit 5:** Numerical Solution of Partial Differential Equations: Representation as a difference equation – Laplace’s equation on a rectangular region – iterative methods for Laplace’s equation – The Poisson equation  
**(18 hours)**

**Book for Study:**

- Jain M.K., Iyengar S.R.K. and Jain R.K., Numerical Methods for Scientific and Engineering Computations, Fourth Edition, New Age International private Limited, New Delhi, 2005.

Unit 1:	Chapter 2	Sections 2.1-2.4, 2.7, 2.8
Unit 2:	Chapter 3	Sections 3.1, 3.2, 3.4
Unit 3:	Chapter 5	Sections 4.5-4.7
- Curtis. F. Gerald, Patrick & O. Wheatley, Applied Numerical Analysis, 5th Edition, Pearson Education, New Delhi, 2008.

Unit 4:	Chapter 4	Sections 4.9 - 4.12
Unit 5:	Chapter 7	Sections 7.3 - 7.6

**Books for References:**

1. Richard L.Barden.J.Bouglas Faires.,*Numerical Analysis*,IX Edition, Cengage Learning, 2011.
2. Radhey.,S.Gupta,Macwillan., *Elements of Numerical Analysis*, 2009.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion.

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Up to
CO1	Determine solutions of the system of equations by applying various methods	K3
CO2	Employ the suitable method of computing solutions to system of linear equations	K3
CO3	Apply various methods of interpolation and interpret on the solutions to the real-life problems	K3
CO4	Calculate derivatives and integrands using numerical methods	K3
CO5	Solve partial differential equations using different methods and analyze its nature of the solutions	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2	2	3				3	2	3	2	2	25
CO2	3	3	2	2	3				3	2	3	2	2	25
CO3	3	3	2	2	3				3	3	3	2	2	26
CO4	3	3	2	2	3				3	2	3	2	2	25
CO5	3	3	2	2	3				3	2	3	2	2	25
Grand Total of COs with POs & PSOs														126
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{126}{50}$														2.52

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.52
Observation	COs of Numerical Analysis are strongly correlated with POs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**  
**Statistics**

(For those who have join from June 2022 onwards)

<b>Class</b>	<b>: M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core-4</b>
<b>Semester</b>	<b>: I</b>	<b>Hours</b>	<b>: 90</b>
<b>Subject Code</b>	<b>: 22PMAC41</b>	<b>Credits</b>	<b>: 5</b>

**Objectives**

This course will facilitate the learners apply and analyze various statistical concepts

**Course Content:**

- Unit 1:** Random variables – probability density function – distribution function – discrete & continuous random variable – mathematical expectations – important inequalities **(18 hours)**
- Unit 2:** Distribution of two random variables – expectation – bivariate random variables - marginal and conditional distributions – correlation coefficient – Independent random variables **(18 hours)**
- Unit 3:** Convergence in probability – convergence in distribution –moment generating functions technique – the central limit theorem **(18 hours)**
- Unit 4:** Generating functions-Laplace transforms- Laplace (Stieltjes) transform of probability distribution of a random variable-Classification of distributions. **(18 hours)**
- Unit 5:** Markov chains definitions and examples-higher transition Probabilities-Generalization of independent Bernoulli trials-Classification of states and chains-determination of higher transition Probabilities-Stability of a Markov system-graph theoretic approach. **(18 hours)**

**Book for Study:**

Robert V Hogg, Allen T Craig, *Introduction to Mathematical Statistics*, Pearson Education, Fifth Edition, Third Indian Reprint, Singapore, 2020.

Unit :1	Chapter 1	Sections	1.5 – 1.10
Unit :2	Chapter 2	Sections	2.1 – 2.6
Unit :3	Chapter 5	Sections	5.1 – 5.4

J. Medhi, *Stochastic Processes*, 4<sup>th</sup> Edition, New Age International (P) Ltd, 2017.

Unit: 4	Chapter 1	Sections	1.1 – 1.4
Unit: 5	Chapter 2	Sections	2.1 – 2.7

**Books for Reference:**

1. Sheldon Ross, A first Course in Probability, Collier Macmillan Publication, 2009.
2. Charles M Grinstead., J.Laurie Snell ., Introduction to Probability, American Mathematical Society, II Revised Edition, 2012.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehend the concepts of random variables and its implications	K2
CO2	Solve the problems based on various distributions	K3
CO3	Determine solutions to the problems using central value limit theorem	K3
CO4	Make inferences on the transforms of probability distribution	K4
CO5	Apply the concepts of Markov chain and Markov processes in finding steady state solutions.	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	3	3	3				3	2	3	3	2	28
CO2	3	3	3	3	3				3	2	3	3	2	28
CO3	3	3	3	3	3				3	2	3	3	2	28
CO4	3	3	3	3	3				3	3	3	2	2	28
CO5	3	3	3	3	3				3	3	3	2	2	28
Grand Total of Cos with POs & PSOs														140
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{140}{50}$														2.8

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.8
Observation	COs of Statistics are strongly correlated with POs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**  
**Graph Theory**

(For those who join from June 2022 onwards)

<b>Class</b>	<b>: M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core Elective 1a</b>
<b>Semester</b>	<b>: I</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAE11 (A)</b>	<b>Credits</b>	<b>: 4</b>

**Objectives:**

This course facilitates the learners to apply and analyze the concepts of trees, matchings, planarity, colourings and networks

**Course Content:**

**Unit 1:** Trees and connectivity- Definition and simple properties – Bridges- Spanning trees – Connector problems- Shortest path problems – Cut vertices and connectivity

**(18 hours)**

**Unit 2:** Matchings – Matchings and augmenting paths- The marriage problem – The personnel assignment problem- matching algorithm for bipartite graphs- Hungarian Algorithm- optimal assignment problem- Kuhn –Munkres algorithm

**(18 hours)**

**Unit3:** Planar graphs- Plane and planar graphs- Euler’s formula- The platonic bodies- Kuratowski’s theorem- Non – Hamiltonian plane graphs- The dual of a plane graphs

**(18 hours)**

**Unit4:** Colourings: Vertex Colouring-Critical graphs-Cliques-Edge Colouring

**(18 hours)**

**Unit5:** Networks: Flows and cuts-The Ford and Fulkerson Algorithm – Separating Sets

**(18 hours)**

**Book for Study:**

John Clark and Derek Allan Holton, *A First Look at Graph Theory*, Allied Publishers Limited, New Delhi, 2005.

Unit 1 :	Chapter 2	Sections	2.1-2.6
Unit 2 :	Chapter 4	Sections	4.1-4.4
Unit 3 :	Chapter 5	Sections	5.1-5.6
Unit 4 :	Chapter 6	Sections	6.1,6.3-6.6
Unit 5 :	Chapter 8	Sections	8.1-8.3

**Books for References:**

1. Chartrand, Gary, and Ping Zhang. *A first course in graph theory*, Courier Corporation, 2013
2. Harary, *Graph Theory*, Narosa Publishing Company, New Delhi, 2008.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Determine solutions to shortest path problems using the notion of spanning tree	K3
CO2	Employ various algorithms in finding solution to assignment problem	K3
CO3	Describe and make inferences on planar graphs	K4
CO4	Apply the suitable algorithm of vertex coloring to solve problems	K3
CO5	Examine the aspects of network on applying respective algorithms	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2	2	3		2		3	3	3	3	2	29
CO2	3	3	2	2	3		2		3	3	3	3	2	29
CO3	3	3	2	2	3		2		3	2	3	3	2	28
CO4	3	3	2	2	3		2		3	3	3	3	2	29
CO5	3	2	2	3	3		2		3	2	2	3	3	28
Grand Total of COs with POs & PSOs														143
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{143}{55}$														2.6

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.6
Observation	COs of Graph Theory are strongly correlated with POs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**  
**Cryptography**  
(For those who join from June 2022 onwards)

**Class** : M.Sc. Mathematics **Part** : Core Elective 1b  
**Semester** : I **Hours** : 90  
**Course Code** : 22PMAE11 (B) **Credits**: 4

**Objectives:**

This course facilitates the learners to gain profound knowledge on encryption and its associated algorithms

**Course Content:**

**Unit I:** Symmetric key encryption Symmetric key encryption-Stream ciphers-Block Ciphers - DES- Modes of operation **(18 Hours)**

**Unit II:** Public-key cryptography Modular arithmetic-Discrete key log function-RSA system. **(18 Hours)**

**Unit III:** Operations in RSA Digital signature-Hash functions-Merkle's method- Probabilistic signatures **(18 Hours)**

**Unit IV:** Discrete logarithm Elgamal's encryption-Digital signature algorithm - Robin's encryption **(18 Hours)**

**Unit V:** Protocols Kerberos-Diffie-Hellman key agreement-Fiat-Shamir identification scheme Zero knowledge **(18 Hours)**

**Book for Study:**

Hans Delfs and Hellmut Knebl , *Introduction To Cryptography*, Springer Publication, 2013

Unit I : Chapter 2	Sections	2.1-2.2
Unit II : Chapter 3	Sections	3.1-3.3
Unit III: Chapter 3	Section	3.4
Unit IV : Chapter 3	Section	3.5
Unit V : Chapter 4	Sections	4.1.1-4.2

**Book for References:**

1. Koblitz., *A course in Number Theory and Cryptography*, Springer Verlag, 2014.
2. Oded Goldreich, *Foundations of Cryptography(Basic Tools)*, Cambridge 2001.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehends the concepts of symmetric key encryption	K2
CO2	Explain RSA system and its implications	K2
CO3	Employ various functions of RSA	K3
CO4	Apply the algorithms of encryption	K3
CO5	Outline the extended features of encryption algorithms	K2

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2			2			2	2	2	2	2	20
CO2	3	3	2			2			3	2	2	2	2	21
CO3	3	3	2			2			3	2	2	2	2	21
CO4	3	3	3	2		2			3	3	2	2	2	25
CO5	3	3	3	2		2			3	3	2	2	2	25
Grand Total of Cos with POs & PSOs														112
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{112}{47}$														2.38

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.38
Observation	COs of Cryptography are strongly correlated with POs		



Class	: M.Sc. Mathematics	Part	: Core-5
Semester	: II	Hours	: 90
Course Code	: 22PMAC52	Credits	: 5

**Objective:**

The course enables the students to acquire profound knowledge and analyze the concepts of dual spaces, inner product spaces, different transformations and quadratic forms

**Course Content:**

- Unit 1:** Dual spaces – vector space homomorphism – dimension – dual spaces – linear functional – dual basis and annihilator **(18 hours)**
- Unit 2:** Inner product spaces – definition – norm – Schwarz-inequality – orthogonal compliment – orthonormal set and Gram–Schmidt orthogonalization process **(18 hours)**
- Unit 3:** Linear transformation – algebra of linear transformations – invertible-minimal polynomial- range and rank - characteristic roots and matrices **(18 hours)**
- Unit 4:** Canonical Forms – triangular form – definition – similar - invariant– nilpotent transformations – Jordan form-trace and transpose **(18 hours)**
- Unit 5:** Hermitian - unitary and normal transformations - quadratic forms: basic properties of quadratic forms – diagonalization of quadratic forms **(18 hours)**

**Book for Study:**

Herstein I.N., *Topics in Algebra*, Second Edition, John Wiley and Sons Pvt. Ltd., Singapore, 2016

Unit 1 :	Chapter 4	Section	4.3
Unit 2 :	Chapter 4	Section	4.4
Unit 3 :	Chapter 6	Sections	6.1 - 6.3
Unit 4 :	Chapter 6	Sections	6.4 - 6.6,6.8
Unit 5 :	Chapter 6	Sections	6.10 - 6.11

**Books for Reference:**

1. Kenneth Hoffman and Ray Kunze, *Linear Algebra*, Pearson Ed, Second Edition first Indian reprint 2003
2. Vijay Khanna., *A course in Abstract Algebra*, V Edition, 2018.
3. Teaching Learning Methods:  
Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the concepts of dual space with illustrations	K2
CO2	Apply Gram–Schmidt orthogonalization process to inner product space	K3
CO3	Examine the concepts of linear transformation through matrix representations	K4
CO4	Make inferences on the canonical forms of linear transformations	K4
CO5	Conceptualize and apply the diagonalization of quadratic forms	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2							3	2	2	3	3	18
CO2	3	3							3	3	3	2	3	20
CO3	3	3							3	2	3	3	2	19
CO4	3	3	3	3	3				3	2	3	3	2	28
CO5	3	3	3	3	3				3	3	3	2	3	29
Grand Total of Cos with POs & PSOs														114
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{114}{41}$														2.78

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.78
Observation	COs of Linear Algebra are strongly correlated with POs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Measure and Integration

(For those who join from June 2022 onwards)

Class : M.Sc. Mathematics

Part : Core-6

Semester : II

Hours : 90

Course Code : 22PMAC62

Credits : 5

**Objectives :**

This course is intended to facilitate the learners analyze the concepts of integrals and measure spaces

**Course Content:**

**Unit 1:** Measure on the real line – Lebesgue outer measure –  $\sigma$  – algebra- Borel set - measurable sets and functions- Lebesgue measurable function – Borel function  
(18 hours)

**Unit 2:** Integration of functions of a real variable: integration of non-negative functions – general integral – integration of series – Riemann and Lebesgue integrals  
(18 hours)

**Unit 3:** Abstract measure spaces – measures and outer measures – completion of a measure – measure spaces – integration with respect to a measure – measure spaces – integration with respect to a measure  
(18 hours)

**Unit 4:**  $L^p$  spaces – convex functions – Jensen’s inequality (18 hours)

**Unit 5:** Convergence in Measure – Almost uniform convergence – Signed Measures and Halin Decomposition – The Jordan Decomposition. (18 hours)

**Books for Study:**

De Barra, G., *Measure Theory and Integration*, First reprint, Wiley Eastern Limited, New Delhi, 2019.

Unit 1: chapter2 Sections 2.1, 2.2, 2.4

Unit 2: Chapter3 Sections 3.1 -3.4

Unit 3: Chapter5 Sections 5.1 -5.6

Unit 4: Chapter6 Sections 6.1, 6.3

Unit 5: Chapter7 Sections 7.1, 7.2 and Chapter8 Section 8.1, 8.2

**Books for References:**

1. Royden.H.L., *Real Analysis*, Prentice Hall of India, III Edition, 2007.
2. Munroe,M.E. *Measure and Integration*. Addison-Wesley Mass. Stockholm, 2009.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehends the concept of Lebesguemeasure with illustrations	K2
CO2	Compare the approaches of Riemann and Lebesgue integrals	K4
CO3	Examine the nature of measure spaces	K4
CO4	Make inferences on the conceptualization of measure space	K4
CO5	Infer on decomposition theorems	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2				3	2	3	3	2	21
CO2	3	3			2				3	2	3	3	2	21
CO3	3	3			2				3	2	3	3	2	21
CO4	3	2			2				3	2	3	3	2	20
CO5	3	3			2				3	2	3	3	2	21
Grand Total of Cos with POs & PSOs														104
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{104}{40}$														2.6

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.6
Observation	Cos of Measure and Integration are strongly correlated with POs		

Class : M.Sc. Mathematics

Part : Core-7

Semester : II

Hours : 90

Course Code : 22PMAC72

Credits : 5

**Objective:**

The course facilitate the learner to apply and analyze various methods of solving differential equations.

**Course Content:**

- Unit 1:** Initial value problems for the homogeneous equation – solutions of the homogeneous equation – Wronskian and linear independence – reduction of the order of a homogeneous equation – non-homogeneous equation **(18 hours)**
- Unit 2:** Homogeneous equations with analytic coefficients – the Legendre equation – the Euler equation – second order equation with regular singular points **(18 hours)**
- Unit 3:** The Bessel's equation – regular singular points at infinity – equations with variables separated – exact equations – the method of successive approximations – Lipschitz condition **(18 hours)**
- Unit 4:** Convergence of the successive approximations – non-local existence of solutions – approximations to solutions – equations with complex valued functions-some special equations-complex n-dimensional space-systems as vector equations **(18 hours)**
- Unit 5:** Eigen Values, Eigenfunctions, and the Vibrating String-Boundary value problems-Derivation of the Wave equation-Solution of the Wave Equation-The Heat equation-The Dirichlet problem for Disc-Poisson Integral-Sturm\_Liouville Problems **(18 hours)**

**Books for Study:**

- Earl A Coddington, *An Introduction to Ordinary Differential Equations*, Prentice-Hall India Private Limited, New Delhi, 2014
 

Unit 1	:	Chapter 3	Sections	3.1 – 3.6
Unit 2	:	Chapter 3	Sections	3.7 -3.8
		Chapter 4	Sections	4.1 - 4.4
Unit 3	:	Chapter 4	Sections	4.7 - 4.9
		Chapter 5	Sections	5.1 - 5.5
Unit 4	:	Chapter 5	Sections	5.6 - 5.9
		Chapter 6	Sections	6.3- 6.5
- George F.Simmons and Steven G.Krantz, *Differential Equations*, McGraw-Hill International Editions, Singapore, 2016
 

Unit 5	:	Chapter 6	Sections	6.2 – 6.5
--------	---	-----------	----------	-----------

**Books for References:**

- Deo S.G. and Raghavendra.V, *Text Book of Ordinary Differential equations and Stability Theory*,Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
- Sankar Rao.S, *Introduction to Partial Differential Equations*, Prentice Hall of India, New Delhi. 2016.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Solve homogeneous equations by using suitable methods	K3
CO2	Apply Legendre and Euler equations and make inferences on the solutions to the differential equations	K3
CO3	Solve Bessel's equation	K3
CO4	Find solutions to Cauchy problem and linear equations	K3
CO5	Employ different methods to solve linear and non-linear partial differential equations	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2	2	3				3	3	3	2	3	27
CO2	3	3	2	2	3				3	2	3	3	3	27
CO3	3	3	2	2	3				3	3	3	2	3	27
CO4	3	3	2	2	3				3	3	3	2	3	27
CO5	3	3	2	2	3				3	3	3	2	3	27
Grand Total of COs with POs & PSOs														135
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{135}{50}$														2.7

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.7
Observation	COs of Differential Equation are strongly correlated with POs		

Class : M.Sc. Mathematics

Part : Core Elective 2a

Semester : II

Hours : 90

Course Code : 22PMAE22 (A)

Credits : 4

**Objectives:**

The course makes the learner apply, analyze and evaluate the concepts and properties of spaces curves and surfaces.

**Course Content:**

**Unit 1:** Space curves-Definition of a space curve - Arc length - tangent - normal and binormal - curvature and torsion - contact between curves and surfaces

**(18 hours)**

**Unit 2:** Tangent surface - Involutives and evolutes - Intrinsic equations - Fundamental Existence Theorem for space curves - Helices

**(18 hours)**

**Unit 3:** Local intrinsic properties of a surface - Curves on a surface - Surface of revolution - Helicoids - Metric - Direction coefficients - Families of curves - Isometric correspondence - Intrinsic properties

**(18 hours)**

**Unit 4:** Geodesics - Canonical geodesic equations - Normal property of geodesics - Geodesics curvature - Gauss - Bonnet Theorem - Gaussian curvature

**(18 hours)**

**Unit 5:** Local non-intrinsic properties of a surface-Principal curvature - Lines of curvature - Developable - Developable associated with space curves and with curves on surface - Minimal surfaces - Ruled surfaces-The fundamental equation of surface theory- Parallel surfaces

**(18 hours)**

**Book for Study:**

Willmore T.J., *An Introduction to Differential Geometry*, Oxford University Press, New Delhi 2014.

Unit 1 : Chapter 1 Sections 1 - 6

Unit 2 : Chapter 1 Sections 7 - 9

Unit 3 : Chapter 2 Sections 1-9

Unit 4 : Chapter 2 Sections 10 -12, 15-17

**Books for References:**

1. Dirk J. Struik, *Lectures on Classical Differential Geometry*, Addison Wesley Publishing Company, 1950
2. Barrett O'Neill, *Elementary Differential Geometry*, Second Edition, Academic Press, 2006.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehends the fundamental concepts of space curves and surfaces	K2
CO2	Characterize the nature of the surfaces and find the involute and evolute of various surfaces	K3
CO3	Infer on the intrinsic properties of surfaces and Helicoids	K4
CO4	Determine Geodesics of different surfaces	K3
CO5	Make inferences on the properties of developable curves and minimal surfaces	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2				3	2	3	3	2	21
CO2	3	3			2				3	3	3	2	2	21
CO3	3	3			2				3	2	3	3	2	21
CO4	3	3			2				3	3	3	2	2	21
CO5	3	2			2				3	2	3	3	2	20
Grand Total of COs with POs & PSOs														104
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{104}{40}$														2.6

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.6
Observation	COs of Differential Geometry are strongly correlated with POs		



ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Research Methodology

(For those who join from June 2022 onwards)

Class	: M.Sc. Mathematics	Part	: Core Elective 2b
Semester	: II	Hours	: 90
Course Code	: 22PMAE22 (B)	Credits	: 4

**Objectives:**

This course enables the learners to understand the basics of research and its associated concepts.

**Course Content:**

**Unit I:** Meaning of research-objectives of research - motivation in research-types of research-research approaches-significance of research- research methods versus methodology-research and scientific method- importance of knowing how research is done-research process - criteria of good research- problems encountered by researchers in India defining the research problem :selecting the problem- necessity of defining the problem- technique involved in defining a problem **(18 Hours)**

**Unit II :**Meaning of research design-need for research design-features of a good design-important concepts relating to research design -different research designs-basic principles of experimental designs. sampling design: census and sample survey- implications of a sample design-steps in sampling design -criteria of selecting a sampling procedure-characteristics of a good sample design-different types of sample designs- random sample from an infinite universe-complex random sampling designs. **(18 Hours)**

**Unit III:** Measurement in research - measurement scales-sources of error in measurement-tests of sound measurement- technique of developing measurement tools-scaling -meaning of scaling-scale classification bases-important scaling techniques-scale construction techniques. **(18 Hours)**

**Unit IV:** Collection of primary data- observation method - interview method- collection of data through questionnaires-collection of data through schedules -difference between questionnaires and schedules-some other methods of data collection- collection of secondary data - selection of appropriate method for data collection-case study method. **(18 Hours)**

**Unit V:** Meaning of interpretation-technique of interpretation-precaution in interpretation-significance of report writing-difference steps in writing report-layout of the research report-types of reports- oral presentation-mechanics of writing a research report **(18 hours)**

**Book for Study:**

Kothari, C.R., *Research Methodology – Methods Techniques*. New Age International Publishers, 2010

Unit I : Chapter 1	Sections	1.1 – 1.12
Chapter 2	Sections	2.1 – 2.4
Unit II : Chapter 3	Sections	3.1-3.6
Chapter 4	Sections	4.1-4.4
Unit III: Chapter 5	Sections	5.1-5.4
Chapter 6	Sections	6.1-6.4

**Book for References:**

1. Yogesh Kumar Singh., *Fundamentals of Research Methodology and Statistics*, New Age International (P) Limited, Publishers, 2015
2. R. L. Dominoswki, *Research Methods*, Prentice Hall, 1981

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Comprehends the basics of research	K2
CO2	Interpret on different types of samplings	K2
CO3	Explain various scales of measurements	K2
CO4	Outlines the different methods of data collection	K2
CO5	Draft research report with essential components	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2		2				2	3	2	2	2	21
CO2	3	3	2		2				3	3	3	3	3	25
CO3	3	3	2		2				3	2	3	3	3	24
CO4	3	3	2		2				2	3	2	2	2	21
CO5	3	3	2		2				2	3	2	2	2	21
Grand Total of COs with POs & PSOs														112
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{112}{45}$														2.49

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.49
Observation	COs of Research Methodology are strongly correlated with POs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Numerical and Statistical Methods

(For those who join from June 2022 onwards)

Class : M.Sc. (Other Major)

Part : NME-1

Semester : II

Hours : 60

Course Code : 22PMAN12

Credits: 4

**Objective:**

This course enables the learners to apply the numerical and statistical methods in solving the real life problems.

**Course Content:**

**Unit 1:** Algebraic and Transcendental Equations: Bisection Method – Iteration Method – The Method of False Position – Newton- Raphson – Method. **(12 hours)**

**Unit 2:** System of linear equation: Gauss elimination, Gauss Jordan elimination – triangularization method –iterative Methods, Jacobi, Gauss-Seidel iteration. **(12 hours)**

**Unit 3:** interpolation with equal intervals – Newton forward and backward formula - central difference formula – Gauss forward and backward formula – Stirling’s formula – Bessel’s formula –numerical differentiation: maximum and minimum values of a tabulated function. numerical integration: trapezoidal rule – Simpson’s rule **(12 hours)**

**Unit 4:** Correlation coefficient – rank correlation coefficient of determination – linear regression – Method of least squares – Fitting of the curve of the form  $ax+b$ ,  $ax^2+bx+c$ ,  $ab^x$  and  $ax^b$  **(12 hours)**

**Unit 5:** Binominal distribution – poisson distribution – normal distribution – properties and applications **(12 hours)**

**Book for Study:**

1. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, Pvt. Ltd., 2012.

Unit 1:	Chapter 2	Sections	2.1-2.5
Unit 2:	Chapter 7	sections	7.5.1,7.5.3,7.6
Unit 3:	Chapter 3	Sections	3.1, 3.3.1-3.3.3, 3.7.1-3.7.3
	Chapter 6	Sections	6.1, 6.2.1, 6.3, 6.4.1-6.4.3
2. S.C. Gupta and V.K. Kapoor, Elements of Mathematical Statistics, Sultan Chand & Sons, (2006).

Unit 4:	Chapter 9	Sections	9.1.1,9.1.2,9.3
	Chapter 10	Sections	10.1,10.3,10.6,10.7.1-10.7.3
Unit 5:	Chapter 7	Sections	7.2,7.3.1
	Chapter 8	Sections	8.2

**Books for References:**

1. Jain M.K., Iyengar S.R.K. and Jain R.K., Numerical Methods for Scientific and Engineering Computations, Fourth Edition, New Age International private Limited, New Delhi, 2005.
2. Sancheti D.C. and Kapoor V.K., *Statistics (Theory, Methods and Applications)*, Sultan Chand and Sons, New Delhi, 7<sup>th</sup> Edition, 2007.

**Teaching Learning Methods:**

Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Determine solutions of the system of equations by applying various methods	K3
CO2	Find the solution to the system of linear equations using suitable methods	K3
CO3	Use various methods of interpolation and iterative methods in solving problems	K3
CO4	Employ correlation and regression to find the relationship between the variables of the study	K3
CO5	Apply Poisson and normal distributions to solve real life problems.	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze K5 = Evaluate K6 = Create

**Mapping Course Outcomes with POs and PSOs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3					2		3	3	3		2	19
CO2	3	3					2		3	3	3		2	19
CO3	3	3					2		3	3	3	3	2	22
CO4	3	3	3				2		3	3	3		2	22
CO5	3	3					2		3	3	3		2	19
Grand Total of Cos with POs & PSOs														101
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{101}{37}$														2.73

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.73
Observation	COs of Research Methodology are strongly correlated with POs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**

**QUESTION PAPER PATTERN (PG)**  
(Core, Core Elective and Non-Major Elective)  
(For those who join from 2022 onwards)  
**INTERNAL (40 MARKS)**

**SECTION – A (8 x 1 = 8)**  
EIGHT multiple choice questions. Each question carries 1 mark. (K1, K2)

**SECTION – B (4x 8 = 32)**  
FOUR questions with internal. Each question carries 8 marks. (K3, K4, K5)

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**  
**SCHEME OF EVALUATION (PG)**

1. Continuous Internal Assessment

	Marks
Test – 1	40
Test – 2	40
Assignment / Seminar	20
	-----
Total	100
	-----

2. Semester Examination                      100 Marks

3. Total Marks = 50% C.I.A + 50% Semester Examinations

A candidate must score a minimum of 23 marks out of 50 in the semester examination and an overall aggregate minimum of 50 marks out of 100 for a pass.

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

<b>Class</b>	<b>: II M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core - 8</b>
<b>Semester</b>	<b>: III</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAC83</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course will enable the learners to comprehend and profusely analyze the concepts of topology

- Unit 1**      **Topological Spaces:** Topological spaces – definition of topological space – basis for a topology – order topology – product topology – projections – subspace topology  
**(18 hours)**
- Unit 2:**      **Continuous Functions:** Closed sets and limit points – closure and interior of a set – Hausdorff space continuous functions – homeomorphism- the pasting lemma – metric topology – sequence lemma – uniform limit theorem.  
**(18 hours)**
- Unit 3:**      **Connectedness and Compactness:** Connected spaces – definition – connected subsets in the real line – intermediate value theorem – path connected – Compact spaces – definition – tube lemma – finite intersection property – compact subspaces of the real line.  
**(18 hours)**
- Unit 4:**      **Countability and Separation Axioms:** The countability axioms – Lindelof space – regular and normal space – the separation axioms – The Urysohn Lemma.  
**(18 hours)**
- Unit 5:**      **Nets and Filters:** Definition and convergence of Nets- Topology and convergence of Nets – Filters and their convergences – Ultrafilters and compactness.  
**(18 hours)**

**Book for Study:**

01. James, R. Munkres, *Topology*, II Edition, Pearson India Education Services Pvt.Ltd,2015.

- Unit 1 :      Chapter 2      sections 12 - 16  
Unit 2 :      Chapter 2      sections 17 - 21  
Unit 3 :      Chapter 3      sections 23 ,24,26 & 27  
Unit 4:      Chapter 4      sections 30-33

02. K.D. Joshi, Introduction to General Topology, I Edition, New Age International (p) Limited publishers

- Unit 5:      Chapter 10      sections 1-4

**Books for Reference:**

1. George F. Simmons, *Introduction to Topology and Modern Analysis*, Tata McGraw-Hill, 16<sup>th</sup> Reprint, 2011.
2. Chandrasekhara Rao, K., *Topology*, Narosa Publishing House, 2nd Reprint, 2015.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain various kinds of topologies with illustrations	K3
CO2	Deduce the implications of lemmas related to continuous functions	K4
CO3	Interpret on the theorems associated with connectedness and compactness	K4
CO4	Analyze the nature of separation axioms of the given topological spaces	K4
CO5	Construct the net and filters on given topological spaces	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2							3	2	3	3	3	19
CO2	3	2							3	2	3	2	2	17
CO3	3	2							3	2	3	2	2	17
CO4	3	2							3	2	2	3	2	17
CO5	3	2							3	2	3	3	2	18
Grand Total of Cos with POs & PSOs														88
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{88}{35}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.5
Observation	Cos of Topology are strongly correlated with POs & PSOs		

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

<b>Class</b>	<b>: II M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core - 9</b>
<b>Semester</b>	<b>: III</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAC93</b>	<b>Credits</b>	<b>: 5</b>

**Objectives :**

This course facilitates the learners acquire intense knowledge and deep sense of analyzing on the characteristics of the dynamical systems.

**Course Content:**

- Unit 1: Survey of Elementary Principles :** Mechanics of a particle- Mechanics of a system of particles-Constraints-D'Alembert's principle and Lagrange's equations – velocity dependent potentials dissipative function – applications of Lagrangian formulation. **(18 hours)**
- Unit 2: Variational Principles and Lagrange's Equation:** Hamilton's principle – some techniques of the calculus of variations – derivation of Lagrange's equations forms – Hamilton's principle – Hamilton's principle to non holonomic systems. **(18 hours)**
- Unit 3: The Two-Body Central Force Problem:** The two-body central force problem – classification of orbits – Virial theorem – differential equation for the orbit and integrable power law potentials. **(18 hours)**
- Unit 4: The Kinematics of Rigid Body Motion:** Bertrand's theorem – Kepler's problem inverse square law force – Kepler's equation of motion & first integrals – Laplace – Runge – Lenz Vector. **(18 hours)**
- Unit 5: The Hamilton Equations of Motion:** Legendre Transformations – the Hamilton equation of motion – Routh Procedure – derivation of Hamilton equation from variation principle – the principle of least action. **(18 hours)**

**Book for Study:**

Herbert Goldstein, "Classical Mechanics, 2<sup>nd</sup> Edition", Twentieth Reprint, Narosa Publishing House, New Delhi, 2007.

Unit 1 :	Chapter 1	Sections 1.4 – 1.6
Unit 2 :	Chapter 2	Sections 2.1 – 2.4
Unit 3 :	Chapter 3	Sections 3.1 – 3.5
Unit 4:	Chapter 3	Section 3.6 – 3.9
Unit 5:	Chapter 8	Sections 8.1 – 8.3, 8.5, 8.6

**Books for Reference:**

1. D. T. Greenwood, "Classical Dynamics", Prentice Hall of India, New Delhi, 1985.
2. N.C.Rane and P.S.C.Joag, "Classical Mechanics", Tata McGraw Hill, 1991.



**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

**Course Outcomes (CO):**

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Apply Lagrangian's equation to various dynamical systems	K3
CO2	Employ Hamilton's principle to non-holonomic system	K3
CO3	Determine the differentiation of central orbits and apply the respective theorems to the problems	K3
CO4	Analyse the implications of Kepler's law	K4
CO5	Summarize the applications of Legendre's transformation	K5

**K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create**

**Mapping Course Outcomes with**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	2	2	3						3	2	3	2	2	19
CO2	2	2	3	2					3	2	3	2	2	21
CO3	2	2	3						3	2	3	2	2	19
CO4	3	2	3						3	2	3	2	2	20
CO5	2	2	2	2	2				3	2	3	2	2	22
Grand Total of Cos with POs & PSOs														101
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{101}{43}$														2.3

**Strong – 3, Medium – 2, Low – 1**

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.3
Observation	Cos of Classical Mechanics are strongly correlated with POs & PSOs		

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

<b>Class</b>	<b>: II M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core - 10</b>
<b>Semester</b>	<b>: III</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAD03</b>	<b>Credits</b>	<b>: 5</b>

**Objective :**

This course aims in making the learners to explore the concepts of analytic functions, conformal mapping, singularities and harmonic functions.

**Course Content:**

- Unit 1: Analytic Function:** Polynomials – rational functions – sequences – series – uniform convergence – power series – Abel’s limit theorem. **(18 Hours)**
- Unit 2: Conformality:** Analytic functions in regions – conformal mapping – length and area – **Linear Transformations:** cross ratio – elementary conformal mappings – elementary Riemann surfaces. **(18 Hours)**
- Unit 3: Complex Integration:** Line Integrals – line Integrals as functions of arcs – Cauchy’s theorems – Cauchy’s integral formula – higher derivatives. **(18 hours)**
- Unit 4: Local Properties of Analytical Functions:** Removable singularities – Taylor’s theorem – zeros and poles – general form of Cauchy’s theorem – calculus of residues – residue theorem – evaluation of definite integrals. **(18 hours)**
- Unit 5: Harmonic functions:** Poisson’s formula – Schwarz’s theorem – power series expansions – Weierstrass theorem – Taylor’s series – Laurent series **(18 hours)**

**Book for Study:**

Lars V Ahlfors, “Complex Analysis”, Tata McGraw-Hill International Edition, Singapore, Third Edition, 1979.

Unit 1: Chapter 2 Sections 1.2 – 1.4, 2.1 – 2.5

Unit 2: Chapter 3 Sections 2.2 – 2.4, 3.1 – 3.5, 4.1 – 4.3

Unit 3: Chapter 4 Sections 1.1, 1.3 – 1.5, 2.1 – 2.3

Unit 4: Chapter 4 Sections 3.1 – 3.4, 4.1, 4.4 – 4.6, 5.1 – 5.3

Unit 5: Chapter 4 Sections 6.1 – 6.4 &

Chapter 5 Sections 1.1 – 1.3

**Books for Reference:**

1. J.B. Conway, “Functions of one complex variables”, Springer - Verlag, International student Edition, Narosa Publishing Co., 1978.
2. E. Hille, “Analytic function Theory”, (2 vols.), Gonm & Co, 1959.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Analyze the nature of the analytical functions and find the radius of convergence of power series	K4
CO2	Test the conformality of mappings and compare various transformations	K4
CO3	Evaluate complex contour integrals by applying Cauchy's theorem and Integral formula	K3
CO4	Classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.	K4
CO5	Illustrate and express the functions of a complex variable as Taylor's series and Laurent's series	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2							3	2	3	2	2	17
CO2	3	3			2				3	2	3	2	2	20
CO3	3	2			2				3	2	3	2	2	19
CO4	3	3			2				3	2	3	2	2	20
CO5	3	2							3	2	3	2	2	17
Grand Total of Cos with POs & PSOs														93
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{93}{38}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	Cos of Complex Analysis are strongly correlated with POs & PSOs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**  
**DEPARTMENT OF MATHEMATICS**  
**OPERATIONS RESEARCH**

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

<b>Class</b>	<b>: II M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core - 11</b>
<b>Semester</b>	<b>: III</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAD13</b>	<b>Credits</b>	<b>: 5</b>

**Objective:**

This course will make the learners comprehend and apply different optimizing techniques

**Course Content:**

**Unit 1: Integer Linear Programming:** Illustrative Applications-Capital Budgeting, Set, Covering Problem, Fixed –Charge Problem, Either –Or And If-Then Constraints - Integer Programming Algorithms: Branch And Bound (B & B) Algorithm – Zero – One Implicit Enumeration Algorithm –Cutting Plane Algorithm. **(18 hours)**

**Unit 2: Deterministic Dynamic Programming:** Recursive Nature Of Computations In DP – Forward And Backward Recursion – Selected DP Applications Cargo – Loading Model – Work Force Size Model –Equipment Replacement Model–Investment Model–Inventory Models. **(18 hours)**

**Unit 3: Probabilistic Inventory Models:** Continuous Review Models - Probabilitized EOQ Model- Probabilistic EOQ Model – Single Period Models- No-Setup Model (Newsvendor Model)- Setup Policy (S-S Policy)- Multiperiod Model. **(18 hours)**

**Unit 4: Classical Optimization Theory:** Unconstrained Extremal Problems – Necessary And Sufficient Conditions – Newton - Raphson Method – Constrained Problems – Equality Constraints – Inequality Constraints- Karush –Kuhn-Tucker Conditions (KKT). **(18 hours)**

**Unit 5: Nonlinear Programming Algorithms:** Unconstrained Nonlinear Algorithms – Direct Search Method – Gradient Method – Constrained Nonlinear Algorithms – Separable Programming – Quadratic Programming **(18 hours)**

**Book for Study:**

Taha H.A., “Operations Research – An Introduction”, IX Edition, Pearson Education Inc, 2011

Unit :1	Chapter 9	Sections 9.1,9.2
Unit :2	Chapter 12	Sections 12.1-12.4
Unit :3	Chapter 16	Sections 16.1-16.3
Unit :4	Chapter 20	Sections 20.1, 20.2
Unit :5	Chapter 21	Sections 21.1,21.2

**Books for Reference:**

1. Kantiswaroop, P.K.Gupta and Manmohan, “Operations Research”, Sultan Chand & Sons, New Delhi,15<sup>th</sup> edition, reprinted 2011.
2. Sharma., “Operations Research”, 2<sup>nd</sup> Edition, Vikas Publishing House Private Limited, New Delhi, 2002.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Find optimal solutions for Integer Linear Programming problems using algorithmic approaches	K3
CO2	Determine solutions for real life applications applying Dynamic Programming approach	K3
CO3	Calculate optimal order quantity of probabilistic inventory models	K4
CO4	Solve the problems using classical optimization theory	K3
CO5	Apply various methods to solve for non linear programming problems.	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2	2	2	2				3	3	3	2	2	24
CO2	3	2	2	2	2				3	3	3	2	2	24
CO3	3	2	2	2	2				3	3	3	2	2	24
CO4	3	2	2	2	2				3	3	3	2	2	24
CO5	3	2	2	2	2				3	3	3	2	2	24
Grand Total of Cos with POs & PSOs														120
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{120}{50}$														2.4

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.4
Observation	Cos of Operations Research are strongly correlated with POs & PSOs		

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

<b>Class</b>	<b>: II M.Sc. Mathematics</b>	<b>Part</b>	<b>: Core Elective – 3a</b>
<b>Semester</b>	<b>: III</b>	<b>Hours</b>	<b>: 90</b>
<b>Course Code</b>	<b>: 22PMAE33 (A)</b>	<b>Credits</b>	<b>: 4</b>

**Objective:**

This course enables the students to connect the real world with mathematics and find mathematical solution for real life problems.

**Course Content:**

**Unit 1: Modeling Change:** Modeling change with difference equations- approximating change with difference equations – solutions to dynamical systems- systems of difference equations.

**(18 hours)**

**Unit 2: The Modeling Process, Proportionality and Geometric Similarity:** Mathematical models – modeling using proportionality – modeling using geometric similarity – automobile gasoline mileage- body weight & height, strength & agility.

**(18 hours)**

**Unit 3: Discrete Probabilistic Modeling:** Probabilistic modeling with discrete systems- modeling component and system reliability- linear regression.

**(18 hours)**

**Unit 4: Optimization of Discrete Models:** An overview of optimization modeling – linear programming - geometric solutions – algebraic solutions – simplex method.

**(18 hours)**

**Unit 5: Modeling with a Differential Equation:** Population growth- prescribing drug dosage- braking distance revisited- graphical solutions of autonomous differential equations- numerical approximation methods- separation of variables.

**(18 hours)**

**Book for study:** Frank R. Giordano, William P. Fox, Steven B. Horton “A First Course in Mathematical Modeling”, Cengage Learning.

Unit 1:	Chapter 1	Section 1.1 to 1.4
Unit 2:	Chapter 2	Section 2.1 to 2.5
Unit 3:	Chapter 6	Section 6.1 to 6.3
Unit 4:	Chapter 7	Section 7.1 to 7.4
Unit 5:	Chapter 11	Section 11.1, 11.4-11.7

**Books for References:**

1. Principles of Mathematical Modeling (Ideas, Methods, Examples) A.A. Samarskii, A.P. Mikhailov © 2002 by Taylor & Francis Group, LLC
2. Mathematical modelling- Applications with GeoGebra., Jonas Hall and Thomas Lingefjärd @ 2017 by John Wiley & Sons.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Examine the implications of difference equations in model formulation	K4
CO2	Analyze the mathematical models framed using statistical methods	K4
CO3	Infer the applications of probabilistic modeling to discrete systems	K4
CO4	Illustrate the applications of mathematical models using Linear programming problems.	K4
CO5	Interpret the intervention of differential equations in mathematical modeling.	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2	2	2				3	3	3	2	3	26
CO2	3	3	2	2	2				3	3	3	2	3	26
CO3	3	3	2	2	2				3	3	3	2	3	26
CO4	3	3	2	2	2				3	3	3	2	3	26
CO5	3	3	2	2	2				3	3	3	2	3	26
Grand Total of Cos with POs & PSOs														130
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{130}{50}$														2.6

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.6
Observation	Cos of Mathematical Modelling are strongly correlated with POs & PSOs		

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class	: II M.Sc. Mathematics	Part	: Core Elective – 3b
Semester	: III	Hours	: 90
Course Code	: 22PMAE33 (B)	Credits	: 4

**Objective:**

This course enable the students comprehend and apply the techniques of solving different types of differential equations.

**Course Content:**

**Unit 1: The concept of variation and its properties** : Euler’s equation - variational properties for functional - functionals dependent on higher order derivatives - functions of several independent variables - some applications to problems of mechanics. **(18 hours)**

**Unit 2: Movable boundary for a functional dependent on two functions** : one sided variations – reflection and refraction of extremals - diffraction of light rays. **(18 hours)**

**Unit 3: Regularity conditions** : - special kinds of kernels - Eigen values and Eigen functions - convolution integral - reduction to a system of algebraic equations – Fredholm alternative - an approximation method. **(18 hours)**

**Unit 4: Method of successive approximations** : iterative scheme - Volterra integral equations - some results about the resolvent kernel - the method of solution of Fredholm equation - Fredholm first theorem **(18 hours)**

**Unit 5: Integral equations** : Initial value problems - boundary value problem -singular integral equations – the Abel integral equations. **(18 hours)**

**Book for study:**

01. A. S. Gupta, Calculus of Variations with Applications, PHI, New Delhi, 2005.

Unit I : Chapter - 1 Sections 1.1 - 1.7

Unit II : Chapter - 2 Sections 2.1 - 2.5

02. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971.

Unit III : Chapter - 1 Sections 1.1 - 1.5

Chapter - 2 Sections 2.1 - 2.5

Unit IV Chapter - 3 Sections 3.1 - 3.5

Chapter - 4 Sections 4.1 - 4.3

Unit V : Chapter - 5 Sections 5.1 - 5.3

Chapter - 8 Sections 8.1 - 8.2

**Books for References:**

Pars, Leopold Alexander. *An introduction to the calculus of variations*. Courier Corporation, 2013.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion



### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Apply vibrational properties to solve higher order differential equations	K3
CO2	Solve problems based on reflection and refraction of extremals	K3
CO3	Use methods based on Eigen values to find solutions to the problems	K3
CO4	Employ iterative methods to find solutions to the given problems	K3
CO5	Obtain and analyse the solutions to initial and boundary value problems using different methods	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3	2	2	2				3	3	3	2	3	26
CO2	3	3	2	2	2				3	3	3	2	3	26
CO3	3	3	2	2	2				3	3	3	2	3	26
CO4	3	3	2	2	2				3	3	3	2	3	26
CO5	3	3	2	2	2				3	3	3	2	3	26
Grand Total of Cos with POs & PSOs														130
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{130}{50}$														2.6

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.6
Observation	Cos of Calculus of Variation are strongly correlated with POs & PSOs		

Functional Analysis

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class	: II M.Sc. Mathematics	Part	: Core - 12
Semester	: IV	Hours	: 90
Course Code	: 22PMAD24	Credits	: 5

**Objective:**

This course enables the learners to comprehend and analyze the associations between algebraic and topological structures.

**Course Content:**

- Unit 1:**      **Algebraic systems** : Linear spaces – dimension of a linear space – linear transformations – algebras **(18 hours)**
- Unit 2:**      **Banach spaces** : Continuous linear transformations – Hahn – Banach theorem – natural imbedding of  $N$  in  $N^{**}$  – open mapping theorem – conjugate of an operator **(18 hours)**
- Unit 3:**      **Hilbert spaces** : Orthogonal complements – orthogonal sets – Bessel’s inequality – conjugate space  $H^*$  **(18 hours)**
- Unit 4:**      **Theory of operators** : Adjoint of an operator – self adjoint operators – normal and unitary operators – projections **(18 hours)**
- Unit 5:**      **Finite dimensional spectral theory** : Matrices – determinants – spectrum of an operator – spectral theorem – general preliminaries on Banach algebras – regular and singular elements **(18 hours)**

**Book for Study:**

Simmons, G. F., *Introduction to Topology and Modern Analysis*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2006.

Unit 1 :	Chapter 8	Sections 42 - 45
Unit 2 :	Chapter 9	Sections 46 - 51
Unit 3 :	Chapter 10	Sections 52 - 55
Unit 4 :	Chapter 10	Sections 56 - 59
Unit 5 :	Chapter 11	Sections 60 - 63
	Chapter 12	Sections 64 - 65

**Books for Reference:**

1. Walter Rudin, *Functional Analysis*, Tata McGraw-Hill publishing Co. Ltd., New Delhi, 2006.
2. Casper Goffman and George Pedrick, *First Course in Functional Analysis*, Prentice Hall of India Private Ltd., 1987.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Apply their knowledge on linear spaces and linear transformations	K3
CO2	Examine the theoretical justifications in Hahn-Banach and Open Mapping theorems and deduce a few applications	K4
CO3	Infer the geometrical properties of orthogonality in Hilbert Spaces	K3
CO4	Classify various operators on Hilbert Spaces	K3
CO5	Illustrate the concepts and implications of finite dimensional spectral theory	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3			2				2	2	3	2	3	20
CO2	3	3			2				3	3	3	2	3	22
CO3	3	3			2				3	3	3	2	3	22
CO4	3	3			2				3	3	3	2	3	22
CO5	3	3			2				2	3	3	2	3	21
Grand Total of Cos with POs & PSOs														107
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{107}{40}$														2.7

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.7
Observation	Cos of Functional Analysis are strongly correlated with POs & PSOs		

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class : II M.Sc. Mathematics

Part : Core - 13

Semester : IV

Hours : 90

Course Code : 22PMAD34

Credits: 5

**Objectives :**

This course enables the learners to gain more insights on the theoretical conceptualization of fuzzy sets and its applications

**Course outline:**

**Unit 1: Classical Sets to Fuzzy Sets & Fuzzy Sets versus Crisp Sets :** Overview of crisp sets – Fuzzy sets- types- basic concepts – additional properties of  $\alpha$ -cuts - representation of fuzzy sets– decomposition theorems of fuzzy sets-extension principle for fuzzy sets.

**(18 hours)**

**Unit 2: Operation on Fuzzy Sets:** Types of operations – fuzzy compliments –First, Second Characterization theorem of fuzzy complements - fuzzy intersections: t-norms – fuzzy union: t-co norms - combination of operations.

**(18 hours)**

**Unit 3: Fuzzy Arithmetic & Fuzzy Relations:** Fuzzy number – linguistic variables – arithmetic operation on intervals – arithmetic operations on fuzzy numbers – binary fuzzy relation- fuzzy equivalence relation-fuzzy compatibility relation-fuzzy ordering relation

**(18 hours)**

**Unit 4: Constructing Fuzzy Sets and Operations on Fuzzy Sets :** Overview of methods of constructing fuzzy sets- direct methods with one expert-direct methods with multiple experts-indirect method with one expert-indirect methods with multiple experts

**(18 hours)**

**Unit 5: Fuzzy Decision Making :** Individual Decision Making - Multi person Decision Making - Multi Criteria Decision Making – Multi Stage Decision Making – Fuzzy Ranking Methods.

**(18 hours)**

**Book for Study :**

01. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic Theory and Applications”, PHI Learning Private Limited, New Delhi, 2016.

Unit 1 : Chapter 1 Sections 1.1 – 1.5

Chapter 2 Sections 2.1 – 2.3

Unit 2 : Chapter 3 Sections 3.1 – 3.5

Unit 3 : Chapter 4 Sections 4.1 – 4.5

Chapter 5 Sections 5.3 – 5.7

Unit 4 : Chapter 10 Sections 10.1 – 10.6

Unit 5 : Chapter 15 Sections 15.1 – 15.6

**Books for Reference:**

01. Zimmermann, “Fuzzy set theory and its applications” Affiliated East West Press Pvt Ltd, 2<sup>nd</sup> Edition, 1996.

02. George J.Klir and Tina A.Folger, “Fuzzy sets, Uncertainty and information” PHI Learning Pvt limited, New Delhi, 2009.

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Illustrate fuzzy set and its properties	K2
CO2	Apply various operations on fuzzy sets and make interpretations	K3
CO3	Correlate fuzzy and crisp approaches in different kinds of relations	K4
CO4	Differentiate the utility of direct and indirect methods in constructing fuzzy sets	K4
CO5	Make inferences on applications of fuzzy decision making models	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	3							3	3	3	2	2	19
CO2	3	3							3	3	3	2	2	19
CO3	3	3							3	3	3	2	2	19
CO4	3	3	3	3	3				3	3	3	3	3	30
CO5	3	2	3	3	3				3	3	3	3	3	29
Grand Total of Cos with POs & PSOs														116
Mean Value of Cos with POs & PSOs =														2.83
$\frac{\text{Grand Total of Cos with Pos \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{116}{41}$														

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.83
Observation	Cos of Fuzzy Sets and Applications are strongly correlated with POs		

**Project**

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

**Class : II M.Sc. Mathematics**

**Part : Core - 14**

**Semester : IV**

**Credits: 5**

**Course Code : 22PMAD44**

**Objective**

This course intends to make the learners acquire intense knowledge on the nuances of research and facilitates them to apply the mathematical concepts to design solutions to social problems

**Course Outline:**

The students undertake the project during the IV semester after the preliminary steps of student allotment to staff and topic selection in the III semester.

The students must attend atleast one conference/seminar at international/national/state level and it is made mandatory for internal assessment.

The student's progress is periodically assessed by the project guide through tests and presentation.

The significant research work is encouraged for presentations and publications in conferences and journals

**Evaluation:**

**Internal – 50 Marks**

Certificate of Participation / Presentation in conferences / seminars at international / national / state level – 10 Marks

Internal Viva-Voce- 15 Marks

Dissertation – 25 Marks

**External Viva-Voce – 50 Marks**

**Total – 100 Marks**

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Gain new insights and apply in the respective field of study	K3
CO2	Illustrate the concept of lab to land in the project	K3
CO3	Develop and apply the nuances of documentation of the works based on mathematical conceptualizations and implications	K3
CO4	Appraise and appreciate mathematical interventions in real life scenario	K4
CO5	Design innovative projects with the application of mathematical concepts towards scientific and societal development	K6

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2	2	2	3		2		3	3	2	3	3	28
CO2	3	2	3	3	3		2		3	3	3	3	3	31
CO3			2	2	2		2					3	2	13
CO4	3	2	3	3	3		2		3	3	3	3	3	31
CO5	3	2	3	2	3		2		3	3	3	3	3	30
Grand Total of Cos with POs & PSOs														133
Mean Value of Cos with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{133}{50}$														2.7

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of Cos with POs & PSOs			2.7
Observation	Cos of Project are strongly correlated with POs & PSOs		

**Automata Theory**

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

**Class : II M.Sc. Mathematics**

**Part : Core Elective - 4a**

**Semester : IV**

**Hours : 90**

**Course Code : 22PMAE44 (A)**

**Credits: 4**

**Objective:**

This course enables the learners to comprehend, apply and analyze the conceptualization and the characteristics of finite automata

**Course Content:**

**Unit 1 : Finite Automata and Regular expressions:** Definitions and examples - Deterministic and Nondeterministic finite Automata- Finite Automata with moves - Regular expressions and their relationship with automation.

**(18 hours)**

**Unit 2 : Context free grammars:** Derivation trees –Simplification of Context free grammas - Chomsky Normal form – Greibach normal form.

**(18 hours)**

**Unit 3 : Pushdown Automata:** Definition and examples - Relation with Context free languages.

**(18 hours)**

**Unit 4 : Finite Automata and lexical analysis-** Role of a lexical analyzer - Minimizing thenumber of states of a DFA -Implementation of a lexical analyzer.

**(18 hours)**

**Unit 5 : Basic parsing techniques-** Parsers - Bottom up Parsers - Shift reduce - operatorprecedence - Top down Parsers - Recursive descent - Predictive parsers.

**(18 hours)**

**Books for Study:**

1. John E. Hopcroft and Jeffrey D. Ullman, *Introduction to Automata theory, Languages and Computations*, Narosa Publishing House, Chennai, 2000.

Unit 1 : Chapter 2 Sections 2.1 – 2.5

Unit 2 : Chapter 4 Sections 4.1 – 4.6

Unit 3 : Chapter 5 Sections 5.2, 5.3

2. A.V. Aho and Jeffrey D. Ullman, *Principles of Compiler Design*, Narosa Publishing House, Chennai, 2002.

Unit 4 : Chapter 3 Sections 3.1 – 3.8

Unit 5 : Chapter 5 Sections 5.1 – 5.5



### Books for Reference:

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall, 1997.
2. A.V. Aho, Monica S. Lam, R. Sethi, J.D. Ullman, Compilers: Principles, Techniques, and Tools, Second Edition, Addison-Wesley, 2007.

### Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Illustrate finite automata and its kinds	K3
CO2	Compare various kinds of grammars and its implications	K4
CO3	Establish automation in relation with context free languages	K3
CO4	Analyze the role of lexical analyzer	K4
CO5	Apply the parsing techniques in generating Strings	K3

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2							3	2	3	2	2	17
CO2	3	3							3	2	3	2	2	18
CO3	3	2							3	2	3	2	2	17
CO4	3	2							3	2	3	2	2	17
CO5	3	3							3	2	3	2	2	18
Grand Total of COs with POs & PSOs														87
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{87}{35}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.5
Observation	COs of Automata Theory are strongly correlated with POs & PSOs		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514

DEPARTMENT OF MATHEMATICS

Fluid Dynamics

(For those who joined in 2022 onwards or later under new CBCS – OBE pattern)

Class	: II M.Sc. Mathematics	Part: Core Elective – 4b
Semester	: IV	Hours : 90
Course Code	: 22PMAE44 (B)	Credits: 4

**Objective:**

This course enables the learners comprehend and analyze the characteristics of fluids motion with mathematical theories and implications.

**Course Content:**

- Unit 1 :** **Real fluids and ideal fluids** – velocity of a fluid at a point – streamlines and path lines steady and unsteady flows – velocity potential – vorticity vector – local and particle rates of change – equation of continuity – worked examples – acceleration of a fluid – conditions at a rigid boundary – general analysis of fluid motion  
**(18 hours)**
- Unit 2 :** **Pressure at a point in a fluid at rest** – pressure at a point in a moving fluid – conditions at a boundary of two inviscid immiscible fluids – Euler’s equations of motion – Bernoulli’s equation – worked examples – discussion of the case of steady motion under conservative body forces – some flows involving axial symmetry – some special two-dimensional flows – some further aspects of vortex motion  
**(18 hours)**
- Unit 3 :** **Sinks and Doublets:** Introduction – sources – axis symmetric flows – Stoke’s stream function – some special forms of the stream function for axis – symmetric irrotational motions  
**(18 hours)**
- Unit 4 :** **Two-dimensional flow:** – use of cylindrical polar co-ordinates – stream function – complex potential for two-dimensional – irrotational – incompressible flow – complex velocity potential for standard two-dimensional flow: uniform stream – line sources and line sinks – line doublets – line vortices – some worked examples – Milne-Thomson circle theorem – some applications of the circle theorem – extension of the circle theorem – theorem of Blasius  
**(18 hours)**
- Unit 5 :** **Stress components in a real fluid:** relations between Cartesian components of stress – translational motion of fluid element – the rate of strain quadric and principal stress  
**(18 hours)**

**Books for Study:**

Chorlton F., Textbook of Fluid Dynamics, New Delhi: CBS Publishers and Distributors. Print. 2004

- Unit 1 : Chapter 1  
Unit 2 : Chapter 2  
Unit 3 : Chapter 3  
Unit 4 : Chapter 4  
Unit 5 : Chapter 5

**Books for Reference:**

- Goyal and Gupta, Fluid Dynamics, Pragati Prakashan Educational Publishers. Print. 2016.
- Bansal J.L, Viscous Fluid Dynamics, Delhi:Oxford & IBH Publishers.Print. 1996

**Teaching Learning Methods:**

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

### Course Outcomes (CO):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Describe the general analysis of fluid motion	K2
CO2	Apply Bernoulli's and Euler's equation of motion to make inferences on the fluid motion	K3
CO3	Use Stoke's stream function in determining the fluid motion	K3
CO4	Make inferences on two dimension flow of the fluid using Milne–Thomson circle theorem & theorem of Blasius	K3
CO5	Compares the Cartesian components of stress and different types of motion	K4

K1 = Remember, K2 = Understand, K3 = Apply, K4 = Analyze, K5 = Evaluate, K6 = Create

### Mapping Course Outcomes with

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Sum of COs with POs & PSOs
CO1	3	2							3	2	3	2	2	17
CO2	3	3							3	2	3	2	2	18
CO3	3	2							3	2	3	2	2	17
CO4	3	2							3	2	3	2	2	17
CO5	3	3							3	2	3	2	2	18
Grand Total of COs with POs & PSOs														87
Mean Value of COs with POs & PSOs = $\frac{\text{Grand Total of Cos with POs \& PSOs}}{\text{Number of Cos relating with POs \& PSOs}} = \frac{87}{35}$														2.5

Strong – 3, Medium – 2, Low – 1

Mapping Scale	1	2	3
Relation	0.01-1.0	1.01-2.0	2.1-3
Quality	Low	Medium	Strong
Mean Value of COs with POs & PSOs			2.5
Observation	COs of Fluid Dynamics are strongly correlated with POs & PSOs		

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR – 625 514**

**DEPARTMENT OF MATHEMATICS**

**QUESTION PAPER PATTERN (PG)**

(Core, Core Elective and Non-Major Elective)  
(For those who join from 2022 onwards)

**INTERNAL (40 MARKS)**

**SECTION – A (8 x 1 = 8)**

EIGHT multiple choice questions. Each question carries 1 mark. (K1, K2)

**SECTION – B (4 x 8 = 32)**

FOUR questions with internal choice. Each question carries 8 marks. (K3, K4, K5)

---

**EXTERNAL (100 MARKS)**

**SECTION – A (10 x 1 = 10 marks)**

TEN multiple choice questions. Each question carries one mark. (K1, K2)

**SECTION – B (5 x 6= 30 marks)**

FIVE questions with internal choice. Each question carries six marks. (K3, K4)

**SECTION – C (5 x 12 = 60 marks)**

FIVE questions with internal choice. Each question carries twelve marks. (K3, K4, K5)

DEPARTMENT OF MATHEMATICS

SCHEME OF EVALUATION (PG)

1. Continuous Internal Assessment

	Marks
Test – 1	40
Test – 2	40
Assignment / Seminar	20
	-----
Total	100
	-----

2. Semester Examination 100 Marks

3. Total Marks = 50% C.I.A + 50% Semester Examinations

A candidate must score a minimum of 23 marks out of 50 in the semester examination and an overall aggregate minimum of 50 marks out of 100 for a pass.