



St. Albert's College (Autonomous), Ernakulam

MAT1CMT0119: MATHEMATICAL METHODS

Course Instructor

Name	Sem, Programme & Batch	Email
	Sem 1, B.Sc(Complementary), 2020-2021	

I. Duration of Course:

No	Activity	Duration
1	Contact hours	72(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	78
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II.Course Objectives:

- calculate partial derivatives of functions of several variables.
- calculate the rank of a matrix.
- compute summation of infinite series.
- solve system of equations using matrix method.
- determine the characteristic roots and characteristic vectors of a Matrix.
- analyse various numerical methods
- find roots of equations by numerical methods

III. Course Delivery Plan

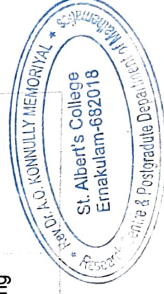
This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, etc.



Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Partial Differentiation: Functions of several variables (Definitions and simple graphs only), Partial derivatives, The Chain Rule.	25/11/2020 to 14/12/2020	Class exercises Lectures Discussions
Matrices: Rank of a Matrix, Elementary transformations of a matrix, Reduction to Normal form, Employment of only row (column) transformations, System of Linear Homogeneous Equations, Systems of linear non homogeneous equations, Characteristic roots and characteristic vectors of a square matrix, Characteristic matrix and Characteristic equation of a matrix, Cayley-Hamilton theorem, Expression of the inverse of a nonsingular matrix A as a polynomial in A with scalar coefficients	15/12/2020 to 08/01/2021	Lectures, Discussions, Class exercises
Trigonometry: Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, and hyperbolic functions, inverse circular and hyperbolic function, Separation into real and imaginary parts, Summation of infinite series based on C + i S method	11/01/2021 to 23/01/2021	Lectures, Class exercises,
Numerical Methods: Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method.	25/01/2021 to 09/02/2021	Lectures, Class exercises

II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Google search and know more about the 'hyperbolic functions'	1 Hour	Self-Learning	
Illustration of the examples of problems in Numerical methods	5 Hours	Experiential learning	



III. Assignments and Seminars Assignments

Sr	Topic	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	4 th December 2020 Submit the assignment before the due date in the Google Classroom
Assignment 2	Assignment on the given topic	Preparation of assignment	8 th January 2021 Submit the assignment before The due date in the Google Classroom

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of date for submission not entertained.

IV. Attendance (one component in class participation):

90-100%	5
85-89%	4
80-84%	3
75-79%	2

Less than 75% **Not eligible for appearing for ESE**

V. Required reading:

1. George B. Thomas, Jr. 'Calculus 12th Edition, Pearson.
2. Peter V. O'Neill, 'Advanced Engineering Mathematics, 7th Edition
3. S. L. Loney - 'Plane Trigonometry Part - II, All India Publishers India, 2009
4. S. S. Sastry - 'Introductory methods of Numerical Analysis, 4th edition (Prentice Hall)

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St. Albert's College (Autonomous), Ernakulam

MAT2CMT00119: CALCULUS

Course Instructor

Name	Sem, Programme & Batch	Email
Sem 2, B Sc(Complementary), 2020-2021		

I. Duration of Course:

No	Activity	Duration
1	Contact hours	72(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	78
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

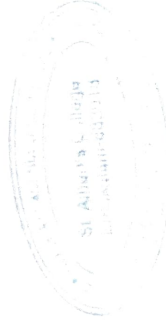
II.Course Objectives:

- Find the area under a given curve, length of an arc of a curve when the equations are given in parametric and polar form.
- Find the area and volume by applying the techniques of double and triple integrals
- Obtain an integrating factor which may reduce a given differential equation into an exact one and eventually provide its solution.
- Describe the origin of partial differential equation and distinguish the integrals of first order linear partial differential equation into complete, general and singular integrals.
- Use Lagrange's method for solving the first order linear partial differential equation

III Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching

methods include lectures, discussions, assignments, etc

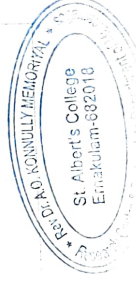


Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Integral Calculus: Volumes using Cross-Sections, Volumes using Cylindrical shells, Arc lengths, Areas of surfaces of Revolution.		Class Exercises, Lectures, Discussions, Illustrations with examples
Multiple Integrals : Double and iterated integrals over rectangles, Double integrals over general regions, Area by double integration, Triple integrals in rectangular co-ordinates.		Lectures, Discussions, Class exercises
Ordinary Differential Equations : Separable Variables, Exact Differential Equation, Equations reducible to exact form, Linear Equations, Solutions by Substitutions, Homogeneous equations and Bernoulli's Equations.		Lectures, Class exercises
Partial Differential Equations : Surfaces and Curves in three dimensions, Solution of equations of the form $\frac{dz}{dx} = \frac{dy}{y} = \frac{dz}{z}$, Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method.		Lectures, Class exercises

IV Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Illustration of the graph with examples	3 Hour	Experiential Learning	1 st Week
Illustration of the examples for finding the volume	5 Hours	Experiential learning	3 rd Week

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V Assignments and Seminars

Assignments

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	Submit the assignment before the due date
Assignment 2	Assignment on the given topic	Preparation of assignment	Submit the assignment before the due date
Assignment 3	Assignment on the given topic	Preparation of assignment	Submit the assignment before the due date

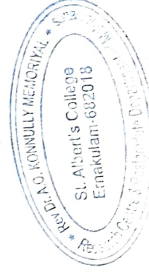
Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VI Attendance (one component in class participation):

90-100%	5
85-89%	4
80-84%	3
76-79%	2
<75	Not eligible for appearing for ESE

VII Required reading:

- George B. Thomas, Jr.: Thomas' Calculus 12th Edition, (Pearson).
- A. H. Siddiqui, P. Manchanda : A first Course in Differential Equations with Applications (Macmillan India Ltd 2006)
- Ian Sneddon : Elements of Partial Differential Equations (Tata Mc Graw Hill)
- Shanti Narayan, P. K. Mittal: Integral Calculus (S. Chand & Company)
- Differential Equations, E. Rukmangadachari, Pearson.
- R. K. Ghosh, K. C. Maity – An introduction to Differential Equations, New Central Books.





St. Albert's College (Autonomous)

PROBABILITY DISTRIBUTIONS

Course Instructor

Name

Dr. Sajithamony T M

Sem, Programme & Batch

Sem 3 BSc, 2020-21

Email

sajithamony@alberts.edu.in

1. Duration of Course:

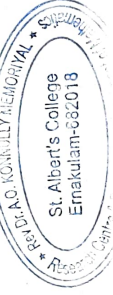
No	Activity	Duration
1	Contact hours	90 (Including assignments)
2	Assessment (CAE & ESE)	6
Total		96
Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)		6

II.Course Objectives:

- The basic concepts like random variables and its expectation, mgf and characteristic functions.
- Understand Chebychev's inequality, Weak Law of Large Numbers- Bernoulli's and Chebychev's form and Central Limit Theorem
- Standard probability distributions like Uniform (discrete/continuous), Bernoulli, binomial, Poisson, geometric, hyper-geometric, exponential, gamma- one and two parameter(s), beta(type I and type II) and Normal distribution with all properties.
- Understand sampling distributions Chi-square, t, F distributions.

III. Course Delivery Plan

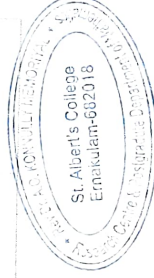
This course is a course requiring lots of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.



Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Expectation of random variables and their functions. Definition of - Raw moments, central moments and their interrelation, A.M, G.M, H.M, S.D, M.D., covariance, Pearson's correlation coefficient in terms of expectation.MGF and characteristic function and simple properties. Moments from mgf. (Problems based on these topics)	25/06/2020 TO 03/08/2020	Class exercises Lectures Discussions Illustration with examples
Uniform(discrete/continuous), Bernoulli, binomial, Poisson, geometric, hyper-geometric, exponential, gamma- one and two parameter(s), beta(type I and type II), - mean, variance, mgf, additive property, lack of memory property. Normal distribution with all properties.(Problems based on these topics).	04/08/2020 TO 27/09/2020	Lectures, Discussions, Class exercises
Chebychev's inequality, Weak Law of Large Numbers- Bernoulli's and Chebychev's form. Central Limit Theorem(Lindberg- Levy form with proof),(Problems based on these topics).	28/09/ 2020 TO 29/10/2020	GD, Lectures, Class exercises, Presentations by students
Concept of sampling from a probability distribution .i.i.d. observations. Concept of sampling distributions, Statistic(s) and standard error(s). Mean and variance of sample mean when sampling is from a finite population. Sampling distribution of mean and variance from normal distribution. Chi-square, t, F distributions and statistics following these distributions. Relation among Normal, Chi-square, t and F distributions.(Problems based on these topics)	30/10/2020 TO 15/12/2020	GD, Lectures, Class exercises

2. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of different research methods using videos	1 Hour	Experiential Learning	1 st Week



Illustrations with examples of theorems and concepts	5 Hours	Experiential learning	2nd Week
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3. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	29th July 2020 Submit the assignment to Google Classroom before 11.59 pm
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	01/08/2020-10/08/2020 Submit the report before 15th August

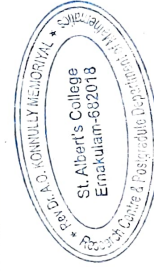
Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

4. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

5. Required reading:

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol.II, 8th edition, World Press, Kolkata.
2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.
3. Hogg R. V., Mclean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.





St. Albert's College (Autonomous), Ernakulam

MAT3CMT0119: Vector Calculus , Analytic Geometry and Abstract Algebra

Course Instructor

Name	Sem, Programme& Batch	Email
Jeema Jose	Sem 3 B.Sc(Complementary), 2020-2021	jeemajose@alberts.ac.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	96
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II.Course Objectives:

- understand the fundamental concepts of vector calculus and apply the various techniques
- of vector integration in solving volume and surface integrals
- To frame equations different conic sections.
- To find focus , directrix and eccentricity of conic sections.
- To define groups, subgroups and cyclic groups.
- To explain different properties of groups.
- To identify examples of groups, cyclic groups. To know vector valued functions and operations on vectors
- To find derivatives of vector valued functions
- Familiar with divergence and curl
- To know Green's theorem , Stokes theorem and Divergence theorem
- Applying above theorems to evaluate volume and surface area.
- To Describe and classify different conics and their properties
- To familiar with group structure, subgroups, cyclic groups and permutation groups

III. Course Delivery Plan

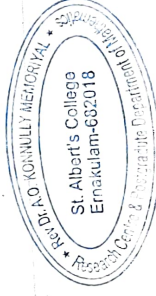
The teaching methods include lectures, discussions, assignments, etc.



Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Vector valued Functions :Curves in space and their tangents, Arc length in space, Curvature and Normal Vectors of a curve, Directional Derivatives and Gradient Vectors.	01/06/2020 to 02/07/2020	Class exercises, Discussions, Lectures
Integration in Vector Fields: Line Integrals, Vector fields and line integrals: Work, Circulation and Flux. Path independence, Conservation Fields and Potential Functions , Green's theorem in Plane (Statement and problems only), Surface area and Surface integral, Stoke's theorem(Statement and Problems only), the Divergence theorem and a Unified theory (Statement and simple problems only). Analytic Geometry: Polar coordinates, Conic sections, Conics in Polar coordinates.	03/07/2020 to 04/08/2020	Lectures, Discussions, Class exercises
	05/08/2020 to 30/08/2020	Lectures, Class exercises
Abstract algebra: Groups, Subgroups, Cyclic groups, Groups of Permutations, Homomorphism.	05/10/2020 to 14/11/2020	Lectures, Class exercises

II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Illustration of example of derivative of vector valued functions with videos	3 Hour	Experiential Learning	1 st week of July
Formation of conics with videos	1 hour	Experiential learning	1 st week of Sep

III. Assignments and Seminars Assignments

No	Topics	Activity	Submission Deadlines	
Assignment 1	Assignment on given topic	Preparation of assignment	09/09/2020	Submit the assignment before the due date
Assignment 2	Assignment on given topic	Preparation of assignment	20/10/2020	Submit the assignment before the due date

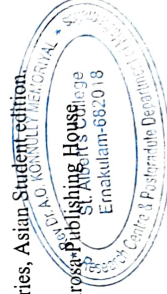
Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

IV. Attendance (one component in class participation):

>90%	A
85-90%	B
80-85%	C
75-80%	D
<75	E-Not eligible for appearing for ESE

V. Required reading:

- George B. Thomas, Jr: Thomas' Calculus Twelfth Edition, Pearson.
- John B Fraleigh – A First course in Abstract Algebra (Seventh Edition) A. H. Siddiqi , P Manchanada : A first Course in Differential Equations with Applications (Macmillan India Ltd 2006)
- Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6th ed.,
- Universal Book Stall, New Delhi.
- Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.
- I.N. Herstein - Topics in Algebra
- Joseph A Gallian - A Contemporary Abstract Algebra, Narosa Publishing House





St. Albert's College (Autonomous), Ernakulam

MAT4CMT0119: FOURIER SERIES, LAPLACE TRANSFORM AND COMPLEX ANALYSIS

Course Instructor

Name	Sem, Programme & Batch	Email
	Sem 4 B Sc(C complementary), 2020-2021	

I. Duration of Course:

No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	96
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II Course Objectives:

- conceive the concept of analytic functions and will be familiar with the elementary complex functions and their properties
- familiar with the theory and techniques of complex integration
- Compute Fourier series of functions
- Compute Laplace transforms of functions
- Solve differential equations using Laplace Transforms

III. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, etc.





St. Albert's College (Autonomous), Ernakulam

MAT4CMT0119: FOURIER SERIES, LAPLACE TRANSFORM AND COMPLEX ANALYSIS

Course Instructor		
Name	Sem, Programme & Batch	Email
	Sem 4 B.Sc(Complementary), 2020-2021	

I. Duration of Course:

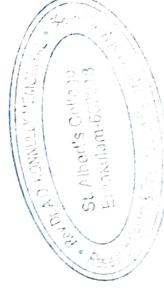
No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	96
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II.Course Objectives:

- conceive the concept of analytic functions and will be familiar with the elementary complex functions and their properties familiar with the theory and techniques of complex integration
- Compute Fourier series of functions.
- Compute Laplace transforms of functions.
- Solve differential equations using Laplace Transforms.

III. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, etc.



Topics

These are the topics to be covered in the modules

Fourier Series and Legendre**Polynomials :**

Periodic Functions, Trigonometric Series, Fourier Series, Functions of

any period $p = 2L$, Even and Odd

functions, Half range Expansions.

A brief introduction to power series and power series method for solving Differential equations. Legendre equation and Legendre polynomials.

Class exercises,
Discussions, Lectures

Laplace Transforms :

Laplace Transform, Inverse Laplace transform, Linearity, Shifting, transforms of Derivatives and Integrals, Differential Equations, Differentiation and Integration of Transforms, Laplace transform general Formulae(relevant formulae only), Table of Laplace Transforms(relevant part only)

Lectures, Discussions,
Class exercises

Complex Numbers and Functions

Complex Numbers, Complex Plane, Polar form of Complex Numbers, Powers and Roots, Derivative, Analytic Functions, Cauchy-Riemann Equations, Laplace's Equation, Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithm, General Power.

Lectures, Class exercises

Complex Integration:

Line Integral in the Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivatives of Analytic functions.

Lectures, Class
exercises



II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Illustration of the graph of periodic functions	3 Hour	Experiential Learning	2 nd week
Google search and know more about the origin of Complex numbers	1 hour	Self-learning	2 nd week

III. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	Submit the assignment before the due date
Assignment 2	Assignment on given topic	Preparation of assignment	Submit the assignment before the due date
Assignment 3	Assignment on the given topic	Preparation of Assignment	Submit the assignment before the due date

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

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IV. Attendance (one component in class participation):

>90%	5
85-90%	4
80-85%	3
75-80%	2
<75	1-Not eligible for appearing for ESE

V. Required reading:

1. Erwin Kreyszig, **Advanced Engineering Mathematics**, Eighth Edition, Wiley, India.
2. Michael D. Greenberg **Advanced Engineering Mathematics**, Pearson Education, 2002.
3. B.S. Grewal, **Higher Engineering Mathematics**, 42nd Edition, Khanna Publishers
4. Brown and Churchill, **Complex Variables and Applications**, McGraw-Hill Higher Education, Edition 8, 2008.





St. Albert's College (Autonomous)

STATISTICAL INFERENCE

Course Instructor

Name

Dr. Sajithamony T M

Sem, Programme & Batch

Sem 4 BSc, 2020-21

Email

sajithamony@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	
2	Assessment (CAE & ESE)	90(Including assignments)
	Total	6
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	96
		6

II.Course Objectives:

- Point and interval estimation of unknown parameters and their significance using large and small samples.
- The basic concepts like hypothesis and its types, types of errors
- Sampling distributions of different statistic: mean, variance, chi-square, t and F
- Understand nonparametric tests for single sample and two samples

III. Course Delivery Plan

This course is a course requiring lots of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.



Session No & Date(s) Methodology and Duration

Topics

These are the topics to be covered in the modules

Point Estimation Concepts of Estimation, Estimators and Estimates. Point and interval estimation. Properties of good estimators- unbiasedness, efficiency, consistency and sufficiency. factorization theorem(statement). (problems based on these topics).

Class exercises

11/12/2020 TO

Lectures

25/01/2021

Discussions

Illustration with examples

Methods of Estimation, Interval Estimation
Methods of moments, maximum likelihood. Invariance property of ML Estimators (without proof), minimum variance. Cramer-Rao inequality(statement only) 100(1- α)% confidence intervals for mean, variance and proportions(problems based on these topics).

26/01/2021 TO

25/02/2021

Lectures, Discussions,
Class exercises

Testing of Hypotheses, Large Sample Tests
Statistical hypotheses, null and alternate hypotheses, simple and composite hypotheses, type-I and type-II errors. Critical Region. Size and power of a test, p-value, Neyman-Pearson approach. Large sample tests - z-tests for means, difference of means, proportion and difference of proportion, chi-square tests for independence, homogeneity.

26/02/2021 TO

29/03/2021

GD, Lectures, Class
exercises, Presentations by
students

Small Sample Tests Normal tests for mean, difference of means and proportion (when σ known), t-tests for mean and difference of means (when σ unknown), paired t-test, test for proportion(binomial), chi-square test, F-test for ratio of variances. (derivation not required)

30/03/2021 TO

28/04/2021

GD, Lectures, Class
exercises

2. Innovative Learning Programmes

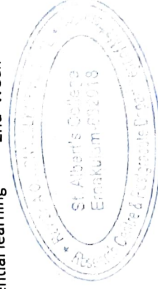
Name of Programme Duration Type Proposed Time
Visualisation of different research methods using videos 1 Hour Experiential Learning 1st Week

illustrations with

examples of theorems
and concepts

Experiential learning

2nd Week



3. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	30 Jan 2021 Submit the assignment to Google Classroom before 11.59 pm
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	01/02/2021 to 10/02/2021 Submit the report before 15th February

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

4. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1

<75

Not eligible for appearing for ESE

5. Required reading:

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. I, 8th edition, World Press, Kolkata.
2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.
3. Hogg R. V., Mekean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.
4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.
5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson EducationInc.
6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.





St. Albert's College (Autonomous)

MATRICULATION - MATHEMATICS DEPARTMENT

Course Instructor

Name

Jeema Jose

Sem, Programme & Batch

Sem V BSc, 2020-21

Email

jeemajose@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	80(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	86
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II. Course Objectives:

- Define and recognize the basic properties of real numbers.
- Define and recognize the series of real numbers and convergence.
- Have the knowledge of real functions-limits of functions and their properties
- Studying the notion of continuous functions and its related theorems
- Recognize the differentiability of real functions and its related theorems.
- Define the real numbers, least upper bounds, and the triangle inequality.
- Define functions between sets; equivalent sets; finite, countable and uncountable sets. Recognize convergent, divergent, bounded, Cauchy and monotone sequences.
- Calculate the limit superior, limit inferior, and the limit of a sequence.
- Recognize alternating, convergent, conditionally and absolutely convergent series.
- Apply the ratio, root, limit and limit comparison tests.

II. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.





St. Albert's College (Autonomous)

MAT5CRT10117 - MATHEMATICAL ANALYSIS

Course Instructor

Name

Jeema Jose

Sem. Programme & Batch

Sem V BSc, 2020-21

Email

jeemajose@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	80(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	86
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

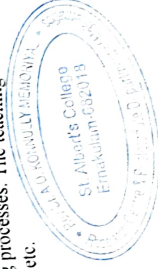
II.Course Objectives:

- Define and recognize the basic properties of real numbers
- Define and recognize the series of real numbers and convergence.
- Have the knowledge of real functions-limits of functions and their properties
- Studying the notion of continuous functions and their properties
- Recognize the differentiability of real functions and its related theorems
- Define the real numbers, least upper bounds, and the triangle inequality.
- Define functions between sets; equivalent sets; finite, countable and uncountable sets. Recognize convergent, divergent, bounded, Cauchy and monotone sequences.
- Calculate the limit superior, limit inferior, and the limit of a sequence.
- Recognize alternating, convergent, conditionally and absolutely convergent series.
- Apply the ratio, root, limit and limit comparison tests.

II. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching

methods include lectures, discussions, assignments, Seminars etc.



Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Finite and Infinite Sets, The Algebraic and Order Properties of $\mathbb{R}$, Absolute Value and Real Line,	1/06/2020 TO	Class exercises
The Completeness Property of $\mathbb{R}$, Applications of the Supremum Property, Intervals,	20/07/2020	Lectures Discussions
		Illustration with examples
Sequences and their Limits, Limit Theorems, Monotone Sequences, Subsequences and the Bolzano- Weierstrass Theorem, The Cauchy Criterion, Properly Divergent Sequences.	21/07/2020 TO 12/09/2020	Lectures, Discussions, Class exercises Analysing limit and continuity using GEOGEBRA
Introduction to Series, Absolute Convergence, Tests for Absolute convergence, Tests for nonabsolute Convergence	13/09/ 2020 TO 11/10/2020	GD, Lectures, Class exercises
Limits of Functions, Limit Theorems, Some Extensions of the Limit Concept.	12/10/2020 TO 14/11/2020	GD, Lectures, Class exercises Visualisation of examples using GEOGEBRA

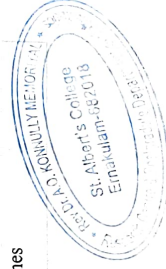
III. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of limit and continuity concepts using GEOGEBRA	3 hours	Experiential Learning	3 rd Week
Illustrations with examples of theorems and concepts	5 Hours	Experiential learning	2nd Week

IV. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
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(Signature)



Submit through Whats app

14th July 2020

Preparation of

Assignment 1 Finding

supremum

and

infimum

Referring text

book and

Assignment 2

Finding

limits of

functions

5th Oct

Submit the assignment to

Google Classroom before

8th Oct

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

V. Attendance (one component in class participation):

4

90-95%

3

85-90%

2

80-85%

1

75-80%

Not eligible for appearing for ESE

<75

VI. Required reading:

1. Robert G Bartle and Donald R Sherbert -Introduction to real analysis 3rd edition.Wiley
2. Richard R Goldberg – Methods of real analysis 3rd edition , Oxford and IBM Publish ing Co (1964)
3. Shanti Narayan – A Course of mathematical analysis, S Chand and Co Ltd(2004)
4. Elias Zako – Mathematical analysis Vol1, Overseas Press, New Delhi(2006)
5. J. M .Howie – Real Analysis, Springer 2007
6. K.A Ross - Elementary Real Analysis, Springer, Indian Reprint
7. M.R Spiegel – Complex Variables, Schaum's Series

Signature





St. Albert's College (Autonomous), Ernakulam

MAT5CRT0317 – ABSTRACT ALGEBRA

I. Course Instructor

Name	Sem, Programme & Batch	Email
GOLDA MARY JOSEPH	Sem 5, B.Sc. Mathematics, 2020-21	goldamary@alberts.edu.in

II. Duration of Course:

No	Activity	Duration
1	Contact hours	90
2	Assessment (CAE & ESE)	7
	Total	97
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	2

III. Course Objectives:

- Recall relation and its types, functions and binary operations.
- Recognize groups with its elementary properties and classifications
- Explain cyclic groups ,normal groups, quotient groups , Isomorphism and homomorphism.
- Relate rings, its types, and elementary properties.
- Understand the subject as tool applicable to almost all other branches of Science, Engineering and Technology

IV. Course Delivery Plan

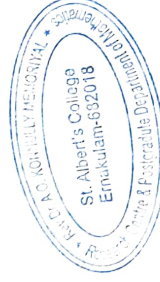
Topics	Session No & Date(s)	Methodology and Duration
Topics	Session No & Date(s)	Methodology and Duration

These are the topics to be covered in the modules
Groups and Subgroups: Binary operation, Groups, Definition and elementary properties- finite groups and

25-06-2020 to 03-08-2020

Class exercises

Lectures



group tables-subsets and sub groups-cyclic sub groups- Elementary Properties
 Permutations, cosets, and direct products- groups of permutations, Cayley's Theorem, Orbits, Cycles and the alternating groups, cosets and the theorem of Lagrange, direct products
 Homomorphisms and factor groups: Homomorphisms, Properties of homomorphisms, factor bases, The fundamental Homomorphism theorem, normal subgroups and inner automorphisms, simple groups
 Rings and fields : Definitions and basic properties, homomorphisms and isomorphisms, Integral domains – divisors of zero and cancellation, integral domains, the characteristic of a rings, Homomorphisms and factor rings

Class exercises

Lectures

04-08-2020 to 27-9-2020

28-9-2020 to 30-10-2020

Class exercises
Lectures

Class exercises
Lectures

30-10-2020 to 15-12-2020

V. Innovative Learning Programmes

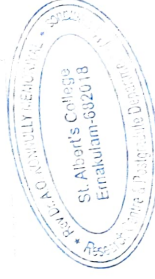
Name of Programme	Duration	Type	Proposed Time
Identifying U_n as a group using Geogebra	1 Day	Skill Development	3 rd week of July
Check Your Understanding using Quizizz	15 min	Assessment	2 nd Week of August
Symmetries of Dihedral Group	1 Day	Experiential learning	1 st Week of September

VI. Assignments and Seminars

Assignments

The following Assignment needs to be submitted to Google Classroom.

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment 1 on given topic	Preparation of assignment	Assignment 1 : Submit the assignment to Google Classroom before 11.59 pm
Assignment 2			Assignment 2 : 4 th September 2020
Assignment 3			Assignment 3 : 22 nd October 2020.
Assignment 4			Assignment 4: 18 th November 2020



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Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 10 - 15 minutes duration	Thursday's of August, September, October & November 2020	Submit the report 2 days before the seminar
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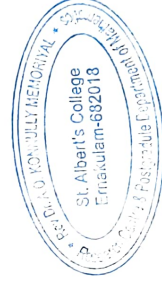
Note: Failure to upload the assignment to Google Classroom on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

VIII. Required reading:

1. John B. Fraleigh - A first course in Abstract Algebra (7th Edition)
2. I.N Herstein - Topics in Algebra
3. Joseph A Gullian - A Contemporary Abstract Algebra, Narosa Pub House.
4. Hillbert - Algebra
5. Artin - Algebra, PHI
6. P.B Bhattacharya, S. K Jain and S. R. Nagpaul - Basic Abstract Algebra, 2nd edition, Cambridge University Press
7. Durbin - Modern Algebra, An introduction, 5th edition, Wiley
8. Chatterjee - Abstract Algebra, 2nd edition, PHI
9. M. K. Sen, S. Ghosh - Topics in Abstract Algebra (University Press)



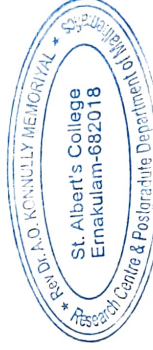
**St. Albert's College
(Autonomous)**
MAT5CRT0417 HUMAN RIGHTS AND MATHEMATICS FOR
ENVIRONMENTAL STUDIES

Course Instructor		Sem, Programme & Batch	Email
Name	Smitha O.	Sem 5 B.Sc. ,2020-21	

I. Duration of Course:		
No	Activity	Duration 72(Including assignments)
1	Contact hours	6
2	Assessment (CAE & ESE)	78
Total		
Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)		6

II.Course Objectives:

- Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental issues. By developing and enhancing critical and creative thinking skills, It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.
- Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future, encourage character building, and develop positive attitudes and values.
- To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment for protecting the nature and natural resources.
- To help the students in acquiring the basic knowledge about environment and to inform the students about the social norms that provide unity with

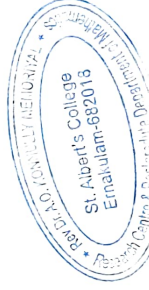


environmental characteristics and create positive attitude about the environment.

III. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc. Methodology and Duration

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Multidisciplinary nature of environmental studies	04/06/2020 TO	Class exercises
Natural Resources	15/07/2020	Lectures
Ecosystems		Discussions
		Presentations by students
Biodiversity and its conservation	16/07/2020 TO	
Environmental Pollution	20/08/2020	Lectures, Discussions, Class exercises
Social Issues and the Environment		Presentations by students
		Lectures, Class exercises
The rabbit problem, Fibonacci numbers, recursive definition, Lucas numbers, Different types of Fibonacci and Lucas numbers. Fibonacci numbers in nature : Fibonacci and the earth, Fibonacci and flowers, Fibonacci and sunflower, Fibonacci, pinecones, artichokes and pineapples, Fibonacci and bees, Fibonacci and subsets, Fibonacci and sewage treatment, Fibonacci and atoms, Fibonacci and reflections, Fibonacci, paraffins and cycloparaffins, Fibonacci and music, Fibonacci and compositions with 1's and 2's.	21/08/ 2020 TO 30/09/2020	
The golden ratio, mean proportional, a geometric interpretation, ruler and compass construction, Euler construction, generation by Newton's method. The golden ratio revisited, the golden ratio and human body, golden ratio by origami, Differential equations, Gattei's discovery of golden ratio, centroids of circles.	03/10/2020 TO 20/11/2020	Lectures, Class exercises
Human Rights	21/11/ 2020 TO	GD, Lectures, Class Discussions
Human Rights and United Nations	10/12/2020	



Environment and Human Rights

II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of Ecosystems, Biodiversity and its conservation	1 Hour	Experiential Learning	1 st Week
Environmental Pollution using videos			
Illustrations with examples of Golden ratio, Fibonacci numbers and similar concepts	5 Hours	Experiential learning	2nd Week

III. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	25th Novemb er 2020
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	01/07/20 20 to 20/08/20 20
			Submit the report before 21 stt August

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

IV. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

[Signature]



V. Required reading:

- 1 Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, 11nd Edition 2013 (TB)
 - 2 Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
 - 3 Cunningham, W.P.Cooper, T.H.Gorham, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p. (Ref)
 - 4 De A.K.Environmental Chemistry, Wiley Eastern Ltd.(Ref)
 - 5 Down to Earth, Centre for Science and Environment (Ref)
 - 6 Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
 - 7 Jadhav.H&Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
 - 8 McKinney, M.L. &Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
 - 9 Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
 - 10 Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA
 - 11 Rao.M.N&Datta.A.K. 1987 Waste Water treatment Oxford 574p (Ref)
 - 12 Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
 - 13 Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
 - 14 Townsend C., Harper J. and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
 - 15 Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Sadards, Vol I and II, Enviro Media (Ref)
 - 16 Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
 - 17 Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
- ### Human Rights
- 1 AmartyaSen, The Idea Justice, New Delhi: Penguin Books, 2009.
 - 2 Chartrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)
 - 3 Law Relating to Human Rights, Asia Law House,2001.
 - 4 Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
 - 5 S.K.Khanna, Children And The Human Rights, Common Wealth Publishers,1998. 2011.
 - 6 SudhirKapoor, Human Rights in 21st Century,Mangal Deep Publications, Jaipur,2001.
 - 7 United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004





St. Albert's College (Autonomous)

DIFFERENTIAL EQUATIONS

I. Course Instructor

Name	Sem, Programme & Batch	Email
Divya Mary Daise S	Sem 5, B.Sc. Mathematics, 2020-21	divyamy@alberts.edu.in

II. Duration of Course:

No	Activity	Duration
1	Contact hours	80
2	Assessment (CAE & ESE)	3
	Total Remedial Sessions/ Peer Tutoring/ Tutorials (need based & Optional)	83
		7

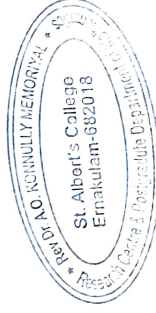
III. Course Objectives:

- To familiarise about differential equations
- To learn to solve ODEs of first and second order
- To understand the power series solution of ODEs
- To know about origin and solution of PDEs

IV. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules separable equations and equations reducible to this form, linear equations, special integrating factors and transformations. Orthogonal and trajectories, Homogeneous equations, reduction of order	25-06-2020 to 03-08-2020	Lectures Discussion Problem Solving Categorising

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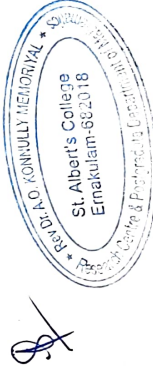


Second order homogeneous linear equation with constant coefficients. The method of undetermined coefficients, Variation of parameters, use of known solution to find another, higher order ODEs	04-08-2020 to 27-9-2020	Lectures Discussion Problem Solving Categorising
Series solutions of first order ODEs, Power series solution about an ordinary point, solutions about singular points, the method of Frobenius	28-9-2020 to 30-10-2020	Lectures Discussion Problem Solving Categorising
Surfaces and Curves in three dimensions, solution of equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method	30-10-2020 to 15-12-2020	Lectures Discussion Problem Solving Categorising

V. Innovative Learning Programmes			
Name of Programme	Duration	Type	Proposed Time
Group Discussion and presentation of challenging exercises from the text book	5 Hour	Research Based Learning	5th Week onwards
Know The Genius - Do literature review and do a presentation (of 15 minutes) about the famous mathematicians involved in the area of study	4 Hours	Literature Review/Flipped Learning	8th Week onwards

VI. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
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Assignment	Assignment topic	Preparation of assignment	Assignment 1: 6 th July 2020	Submit the assignment book on or before 16 th July 2020
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Assignment 2: 4 th August 2020	Submit the assignment book on or before 14 th August 2020
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Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

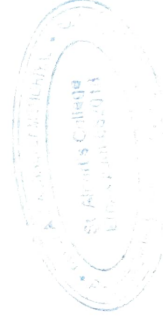
95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

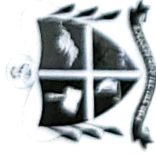
VIII. Required reading:

- G F Simmons, S G Kranz - Differential Equations, Tata McGraw Hill
- Ian Sneddon - Elements of Partial Differential Equation (Tata Mc Graw Hill)
- Shepley L. Ross - Differential Equations, 3rd ed., (Wiley India).
- A.H.Siddiqui & P Manchanda - A First Course in Differential Equation with Applications (Macmillan)
- George F. Simmons - Differential equation with applications and historical notes (Tata Mc Graw Hill)
- W.E. Boyce & R.C. DiPrima - Elementary Differential Equations and boundary value Problems, (Wiley India)
- S. Balachandra Rao & H. Ramadha - Differential Equation with Applications and Programs (Universities Press)
- R. K. Ghosh & K. C. Maiti - An Introduction to Differential Equations (New Central Books Agency)
- B. K. Dutta - Introduction to Partial Differential Equations (New Central Books) .
- Differential Equations Macmillan
- E. A. Coddington - An Introduction to Ordinary Differential Equation, PHI.
- Sankara Rao - Introduction to Partial Differential Equation, 2nd edition, PHI
- Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

Murthy

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St. Albert's College (Autonomous)

MAT6CRT0317 – COMPLEX ANALYSIS

I. Course Instructor

Name	Sem, Programme & Batch	Email
GOLDA MARY JOSEPH	Sem 6, B.Sc. Mathematics, 2020-21	goldamary@alberts.edu.in

II. Duration of Course:

No.	Activity	Duration
1	Lectures	44
2	Tutorials	6
3	Assignments	90

Experiments, Seminars, Peer Learning, Tutorials, need based & Optional.

III. Course Objectives:

- Conceive the concept of analytic functions and will be familiar with the elementary complex functions and their properties
- Familiar with the theory and techniques of complex integration
- Apply Cauchy's theorem and Cauchy's integral formula to compute definite integrals
- Familiar with the theory and application of the power series expansion of analytic functions
- Calculate residues using Cauchy's residue theorem
- Compute definite integrals between limits $-x$ to x .
- Extend the idea of integration in the complex field by using residues and evaluating contour integrals

IV. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
Topics	Session No & Date(s)	Methodology and Duration

These are the topics to be covered in the modules

A quick review on complex numbers and its properties, vectors and modulus, complex conjugates, exponential forms of arguments, and its properties, roots of

02/12/2019 to 09/12/2020 CLASS EXERCISES

Lectures



complex numbers, and regions in complex plane

Functions of a complex variable-limits-theorems on limits-continuity-derivatives-differentiation formulas-Cauchy-Riemann equations-sufficient condition for differentiability-analytic functions examples-harmonic functions. Exponential function –logarithmic function –complex exponents –trigonometric functions- hyperbolic functions- inverse trigonometric and hyperbolic functions.

11-12-2020 to 18-2-2021

Class exercises

Lectures

Derivatives of functions- definite integrals of functions- contours- contour integrals- some examples- upper bounds for moduli of contour integrals –ant derivatives –Cauchy-Goursat theorem (without proof)- simply and multiply connected domains- Cauchy's integral formula- an extension of Cauchy's integral formula- Liouville's theorem and fundamental theorem of algebra- maximum modulus principle.

19-02-2020 to 20-03-2021

Class exercises
Lectures

Convergence of sequences and series
-Taylor's series- proof of Taylor's theorem-examples- Laurent's series(without proof)-examples

21-03-2021 to 31-03-2021

Class exercises
Lectures

Isolated singular points –residues
-Cauchy's residue theorem –three types of isolated singular points-residues at poles-examples –evaluation of improper integrals-example –improper integrals from Fourier analysis –Jordan's lemma (statement only) –definite integrals involving sines and cosines.

08-04-2021 to 28-04-2021

Class exercises
Lectures

V. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Know the man 'Cauchy'- Prepare a short report about 'Augustus Cauchy- His life & Contributions'	1 Week	Self Learning	2 nd week of December
'Stereographic Projection'	1 Week	Self Learning	2 nd week of February

Source:

<https://nptel.ac.in/courses/112/106/112106223/>

[Signature]



VI. Assignments and Seminars

The following Assignment needs to be submitted to Google Classroom.

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	Assignment 1 : 6 th January 2021 Submit the assignment to Google Classroom before 11.59 pm Assignment 2 : 8 th February 2021 Assignment 3 : 13 th April 2021 Assignment 4 : 23 th April 2021
Seminar	Power Point Presentation on given topic	Presentation of 15-30 minutes duration	22-04-2021 to 30-04-2021 Submit the report 2 days before the seminar

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

VIII. Required reading:

1. James Ward Brown & Ruel. V. Churchill- Complex variables and applications (8th edition)
2. Lars V. Ahlfors - Complex Analysis – An Introduction to the Theory of Analytic Functions of one Complex Variables (4th edition), (McGRAW-HILL)
3. Shanti Narayan - Theory of functions of a complex variable
4. Kasana - Complex Variables: Theory and Applications , 2nd edition
5. B. Choudhary - The Elements of Complex Variables.
6. A. David Wunsch – Complex Analysis with Applications (Pearson)

[Signature]





St. Albert's College (Autonomous)

MAT6CRIA17 REAL ANALYSIS

Course Instructor

Name	Sem, Programme & Batch	Email
Anju M M	Sem VI BSc, 2020-21	@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	80 (Including assignments)
2	Assessment (CAE & ESE)	6
Total		86
Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)		6

II. Course Objectives:

- To have a knowledge about the convergence of series
- Familiar with Cauchy criterion for series
- Familiar with the convergence tests such as comparison test, ratio test, Raabe's test, root test and Gauss test
- Have a knowledge about alternating series and absolute convergence
- Studying the notion of real continuous functions and their properties.
- To study the notion of uniform continuity
- Familiar with Riemann integration and integrable functions
- Recognize the Riemann integrable real functions and its related theorems
- Familiar with the test for uniform convergence of series, Weierstrass's M-test, Abel's test, Dirichlet's test
- Distinguish pointwise convergence and uniform convergence

III. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.



Topics	Session No & Date(s)	Methodology and Duration
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These are the topics to be covered in the modules

Continuous Functions, Combinations of Continuous Functions, Continuous Functions on Intervals, Uniform continuity, Monotone and Inverse functions.

7/12/2020 TO
4/01/2021
Class exercises
Lectures
Discussions

Illustration with examples

The Derivative, The Mean Value Theorem, L'Hospital Rules, Taylor's Theorem

18/01/2021 TO
11/02/2021
Lectures, Discussions,
Class exercises

Analysing limit and continuity using
GEOGEBRA

The Derivative, The Mean Value Theorem, L'Hospital Rules, Taylor's Theorem

12/02/2021 TO
16/03/2021
GD, Lectures, Class
exercises

The Derivative, The Mean Value Theorem, L'Hospital Rules, Taylor's Theorem

GD, Lectures, Class
exercises

17/03/2021 TO
30/04/2021

Visualisation of examples
using GEOGEBRA

III. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of limit and continuity concepts using GEOGEBRA	3 hours	Experiential Learning	3 rd Week
Illustrations with examples of theorems and concepts	5 Hours	Experiential learning	2 nd Week

IV. Assignments and Seminars Assignments

No	Topics	Activity	Submission Deadlines
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Assignment 1	Establishing continuity of functions	Preparation of assignment	15th Dec 2020	Submit the assignment to Google Classroom before 17 th Dec
Assignment 2	Establishing uniform convergence of sequences	Referring text book and	18 th Jan 2021	Submit the assignment to Google Classroom
Assignment 3	Testing uniform convergence		12 th Feb 2021	Submit the assignment to Google Classroom

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

V. Attendance (one component in class participation):

90-95% 4

85-90% 3

80-85% 2

75-80% 1

<75

Not eligible for appearing for ESE

VI. Required reading:

1. Robert G Bartle and Donald R Sherbert - Introduction to Real Analysis , (3rd Edition) John Wiley
2. & Sons,
3. Richard R Goldberg - Methods of real Analysis, 3rd edition , Oxford and IBM Publishing Company (1964)
2. Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)
3. Elias Zakon - Mathematical Analysis Vol 1, Overseas Press, New Delhi (2006)
4. J M Howie - Real Analysis, Springer 2007.
5. K A Ross- Elementary - Real Analysis, Springer, Indian Reprints
6. S C Malik, Savitri Arora - Mathematical Analysis, Revised Second Edition

[Signature]





St. Albert's College (Autonomous)

GRAPH THEORY AND METRIC SPACES

I. Course Instructor

Name	Sem. Programme & Batch	Email
	Sem 6, B.Sc. Mathematics, 2020-21	

II. Duration of Course:

No	Activity	Duration
1	Contact hours	80
2	Assessment (C.A.E & E.S.E)	3
	Total	83
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	7

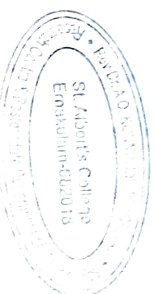
III. Course Objectives:

- Familiarise the basic concepts and famous applications of graph theory
- Learn about the basics of metric spaces and topology

IV. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
An introduction to graph. Definition of a Graph, Graphs as models, More definitions, Vertex Degrees, Sub graphs, Paths and cycles The matrix representation of graphs (definition & example only)	02-12-2020 to 09-12-2020	Lectures Description of real life examples Class discussions
Trees and connectivity. Definitions and Simple properties, Bridges, Spanning trees, Cut vertices and connectivity. Euler	11-12-2020 to 18-2-2021	Lectures Description of real life examples

[Signature]



Tours and Hamiltonian Cycles .Euler's
Tours, The Chinese postman problem
Hamiltonian graphs, The travelling
salesman problem

Class discussions

Metric spaces - definitions and examples, 19-02-2020 to 20-03-2021
open sets, closed sets, cantor set

Lectures
Description of real life
examples

Convergence, completeness, continuous 21-03-2021 to 31-03-2021
mapping

Class discussions
Problem Solving
Lectures
Class discussions

V. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Group Discussion and presentation of challenging exercises from the text book	5 Hour	Research Based Learning	5th Week onwards
Know The Genius - Do literature review and do a presentation (of 15 minutes) about the famous mathematicians involved in the area of study	4 Hours	Literature Review/Flipped Learning	8th Week onwards

VI. Assignments and Seminars Assignments

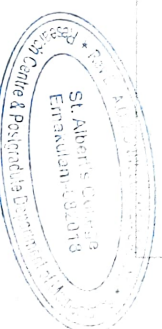
No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment 1 on given topic	Preparation of assignment	Assignment 1 : 6 th January 2020 Assignment 2 : 4 th February 2021 Submit the assignment book on or before 14 th February 2021

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%

5

90-95%
85-90%
80-85%
75-80%

4
3
2
1

<75

Not eligible for appearing for ESE.

VIII. Required reading:

- John Clark Derek Allen Holton - A first look at graph theory, Allied Publishers
- G F Simmons - Introduction to Topology and Modern Analysis
- Douglas B West Peter Grossman - Introduction to Graph Theory
- W.D. Wallis - A Beginner's Guide to Discrete Mathematics, Springer
- R. Balakrishnan, K. Ranganathan - A textbook of Graph Theory, Springer International Edition
- S. Arumugham, S. Ramachandran - Invitation to Graph Theory, Scitech. Peter Grossman,
- J.K. Sharma - : Discrete Mathematics(2nd edition), (Macmillan)
- S. A. Choudam –A First Course in Graph Theory (Macmillan)

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St. Albert's College (Autonomous)

MAT6CRT0417: LINEAR ALGEBRA

Course Instructor

Name

Sem, Programme & Batch	Email
Sem 6 B.Sc., 2020-21	

I. Duration of Course:

No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	96
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II.Course Objectives:

- Understand vector spaces as an abstract algebraic system and establish some of the properties of such systems
- Find the widest applications of linear algebra in Physics, Chemistry, Economics etc.
- Find the eigenvalues and eigenvectors of a matrix.
- Define eigenvalues and eigenvectors geometrically.
- Use characteristic polynomials to compute eigenvalues and eigenvectors.
- Use eigenspaces of matrices, when possible, to diagonalize a matrix.

III. Course Delivery Plan

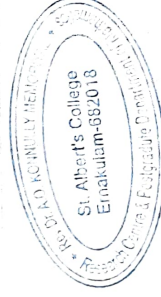
This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.

Topics

Session No & Date(s)	Methodology and Duration
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These are the topics to be covered in the modules

11/12/2020 TO	Class exercises
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A review of algebra of matrices is followed by some applications of matrices, analytic geometry, systems of linear equations and difference equations. Systems of linear equations, elementary matrices, the process of Gaussian elimination, Hermite or reduced row-echelon matrices. Linear combinations of rows (columns), linear independence of columns, row equivalent matrices, rank of a matrix, column rank, normal form, consistent systems of equations.

25/01/2021

Lectures

Discussions

Illustration with examples

Invertible matrices, left and right inverse of a matrix, orthogonal matrix, vector spaces, subspaces, linear combination of vectors, spanning set, linear independence and basis.

26/01/2020 TO

25/02/2021

Lectures, Discussions,
Class exercises

GD, Lectures, Class
exercises.

Linear mappings Linear transformations, Kernel and range, Rank and Nullity, Linear isomorphism Matrix connection: Ordered basis, Matrix of f relative to a fixed ordered basis, Transition matrix from a basis to another. Nilpotent and index of nilpotency.

26/02/ 2021 TO

29/03/2021

30/03/2021 TO
28/04/2021

GD, Lectures, Class
exercises

Eigenvalues and eigenvectors: Characteristic equation, Algebraic multiplicities, Eigen space, Geometric multiplicities, Eigenvector, diagonalisation, Tri-diagonal matrix.

II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of vector space and examples using videos	1 Hour	Experiential Learning	1 st Week
Illustrations with examples of theorems and concepts	5 Hours	Experiential learning	2nd Week

III. Assignments and Seminars Assignments

No	Topics	Activity	Submission Deadlines
Assignment I	Vector space and its examples	Preparation of assignment	30th January 2021
			Submit the assignment to Google Classroom before 11.59 pm





Assignment 2 Eigen values, eigen vectors, eigen space	Preparation of assignment	30th April 2021	Submit the assignment to Google Classroom before 11.59 pm
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Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained

IV. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

V. Required reading:

1. S. Blyth and E. F. Robertson: Basic Linear Algebra, Springer, Second(2002)
2. Richard Bronson, Gabriel B. Costa - Linear Algebra An Introduction (Second Edition), Academic Press 2009, an imprint of Elsevier.
3. David C Lay Linear Algebra, Pearson
4. Sheldon Axler - Linear Algebra Done Right (Third Edition, Undergraduate text Mathematics), Springer 2015.
5. S. H. Friedberg, Arnold J Insel and Lawrence E. Spence, Linear Algebra, 2nd Edition, PHI Inc.in
6. S. Kumarasan Linear Algebra A Geometric Approach, Prentice Hall India Learning Private Limited, New title edition (2000) 6 Gilbert Strang-Linear Algebra and its applications, Thomson Learning





St. Albert's College (Autonomous)

PMT
MEE CRT0319 BASIC TOPOLOGY

Course Instructor

Name	Sem, Programme & Batch	Email
Jeema Jose	Sem 1 MSc ,2020-21	jeemajose@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	96
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

II.Course Objectives:

- Work with topological definitions and theorems
- Produce examples and counter examples that illustrate why theorem hypotheses are necessary or why a statement is not true
- Draw pictures to represent topological ideas
- Formulate conjectures about topological concepts and test these conjectures.
- Prove topological statements
- Use topological ideas (e.g., homeomorphisms, fundamental group) to classify spaces.
- Present mathematical arguments both orally and in writing.

II. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.

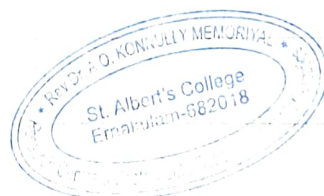
Topics

Session No &
Date(s)

Methodology and Duration

These are the topics to be covered in the modules

B



Topological Spaces: Definition of a topological space – Examples of topological spaces-Bases and subbases – subspaces.	15/12/2020	Lectures Discussions Videos	Illustration with examples
Basic concepts: Closed sets and Closures – Neighbourhoods, Interior and Accumulation points – Continuity and Related Concepts – Making functions continuous , Quotient spaces	16/12/2020 TO 04/01/2021	Lectures, Discussions, Class exercises	
Spaces with special properties :- Smallness conditions on a space, Connectedness	05/01/ 2021 TO 27/01/2021	GD, Lectures, Class exercises, Presentations by students	
Spaces with special properties :- Local connectedness and Paths	28/01/2021 TO 06/03/2021	GD, Lectures, Class exercises	
Separation axioms:- Hierarchy of separation axioms		Visualisation of examples using GEOGEBRA	

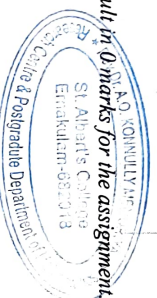
III. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of topologically equivalent objects using videos	1 Hour	Experiential Learning	1 st Week
Illustrations with examples of theorems and concepts	5 Hours	Experiential learning	2nd Week
Visualisation of examples using GEOGEBRA	3 hrs	Experiential learning	6 th week

IV. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	23rd Jan 2021 Submit the assignment to Google Classroom before 11 pm on 24 th Jan 2021
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	13/02/2021 to 03/03/2021 Submit the report before 11 th Feb

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment.



V. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

VI. Required reading:

1. K.D Joshi, Introduction to General Topology, Wiley Eastern Ltd, 1984
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGrawHill Book Company, 1963
3. I.M. Singer & J. A. Thorpe, Lecture Notes on Elementary Topology & Geometry, Springer Verlag 2004
4. Munkres J.R, Topology-A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
5. J.L Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
6. Stephen Willard, General Topology, Addison-Wesley.
7. Dugundji, Topology, Universal Book Stall, New Delhi.







St. Albert's College (Autonomous)

PMT3CRT0219 - PARTIAL DIFFERENTIAL EQUATIONS

I. Course Instructor

Name	Sem, Programme & Batch	Email
	Sem 3, M.Sc. Mathematics, 2020-21	

II. Duration of Course:

No	Activity	Duration
1	Contact hours	75
2	Assessment (CAE & ESE)	5
	Total	80
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	10

III. Course Objectives:

- To learn about Pfaffian differential forms and equations and Solution of Pfaffian differential equations in three variables
- To understand about Linear equations of first order and their solutions
- To study about Nonlinear partial differential equation of the first order and their solutions using Charpit's Method and Jacobi's Method
- To learn more about Laplace Equations and its solutions

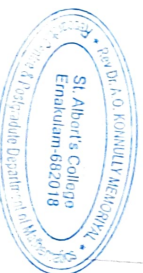
IV. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules	Session No & Date(s)	Methodology and Duration

Module 1: Methods of solutions of $dx/P = dy/Q = dz/R$. Orthogonal trajectories of a system of curves on a surface. Pfaffian differential forms and equations. Solution of Pfaffian differential equations in three variables. Partial differential equations. Origins of first order partial differential equation.

01/06/20 to 07/07/20

Lectures, Discussions, Assignments, Class exercises



Module 2: Linear equations of first order Integral surfaces passing through a given curve. Surfaces orthogonal to a given system of surfaces. Nonlinear partial differential equation of the first order. Compatible systems of first order equations - Charpit's Method. Special types of first order equations. Solutions satisfying given conditions.	09:07:30 to 09:09:20	Lectures, Discussions, Assignments, Class exercises
Module 3: Jacobi's method. The origin of second order equations. Linear partial differential equations with constant coefficients. Equations with variable coefficients.	11:09:20 to 08:10:20	Lectures, Discussions, Assignments, Class exercises
Module 4: Separation of variables. Non linear equations of the second order. Elementary solutions of Laplace equation. Families of equipotential surfaces. The two dimensional Laplace Equation Relation of the Logarithmic potential to the Theory of Functions.	09:10:30 to 10:11:20	Lectures, Student Presentations, Discussions

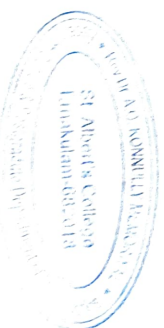
V. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Group Discussion and presentation of challenging exercises from the text book	5 Hour	Research Based Learning	5th Week onwards
Journey to Origin - Do literature review and do a presentation (of 15 minutes) about the origin and applications of the famous PDEs.	4 Hours	Literature Review/Flipped Learning	8th Week onwards

VI. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	9 th June 2020 Submit the assignment before 19 th June 2020
Assignment 2	Assignment on given topic	Preparation of assignment	6 th September 2020 Submit the assignment before 16 th September 2020

Note: Failure to upload the assignment to on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.



V

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Module 2: Linear equations of first order: Integral surfaces passing through a given curve. Surfaces orthogonal to a given system of surfaces. Nonlinear partial differential equation of the first order. Compatible systems of first order equations. Charpit's Method. Special types of first order equations. Solutions satisfying given conditions.

Module 3: Jacobi's method The origin of second order equations. Linear partial differential equations with constant coefficients. Equations with variable coefficients.

Module 4: Separation of variables. Non linear equations of the second order. Elementary solutions of Laplace equation. Families of equipotential surfaces. The two dimensional Laplace Equation Relation of the Logarithmic potential to the Theory of Functions.

(09/07/20 to 09/09/20)

Lectures, Discussions, Assignments, Class exercises

11/09/20 to 08/10/20

Lectures, Discussions, Assignments, Class exercises

09/10/20 to 20/11/20

Lectures, Student Presentations, Discussions

V.

Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Group Discussion and presentation of challenging exercises from the text book	5 Hour	Research Based Learning	5th Week onwards
Journey to Origin - Do literature review and do a presentation (of 15 minutes) about the origin and applications of the famous PDEs.	4 Hours	Literature Review/Flipped Learning	8th Week onwards

VI. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment 1 on given topic	Preparation of assignment	9 th June 2020 Submit the assignment before 19 th June 2020
Assignment 2	Assignment 2 on given topic	Preparation of assignment	6 th September 2020 Submit the assignment before 16 th September 2020

Failure to upload the assignment to on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.




VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	

Not eligible for appearing for ESE

VIII. Required reading:

- Ian Sneddon , Elements of Partial Differential Equations, Mc Graw Hill Book Company
- Phoolan Prasad and Renuka Ravindran, Partial Differential Equations, New Age International
- K Sankara Rao, Introduction to Partial Differential Equations, Prentice Hall of India
- E T Copson, Partial Differential Equations, S Chand and Co





St. Albert's College (Autonomous)

PMT3CRT0419 - FUNCTIONAL ANALYSIS

Course Instructor

Name	Sem, Programme & Batch	Email
Divya Mary Daise S	Sem 3, M Sc Mathematics, 2020-21	divyamary@alberts.edu.in

I. Duration of Course:

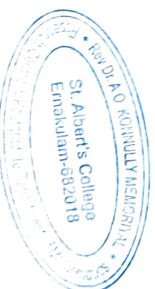
No	Activity	Duration
1	Contact hours	85(Including assignments)
2	Assessment (CAE & ESE)	5
Total		90
Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)		5

II. Course Objectives:

- To understand about some commonly used complete metric spaces
- To familiarise the concepts of normed spaces and Banach Spaces
- To learn about Linear Operators, Bounded Linear Operators, Linear Functionals, Bounded Linear Functionals and Dual Spaces
- To know about Innerproduct Spaces and Hilbert Spaces and the well known results like Schwarz Inequality, Bessel's Inequality, Projection Theorem, Riesz Representation etc.
- To learn about the Hilbert Adjoint Operators and Adjoint Operators and the well known

Hahn-Banach Theorem

III. Course Delivery Plan



The teaching methods include lectures, discussions, assignments, seminars etc.

Topics

Semester No. 6
[Unit VI]

Mathematical and Physical

These are the topics to be covered in the modules

19/10/2020

Lectures, Discussions

Module 1: Examples, Completeness proofs, (completion of Metric Spaces, Vector

19/10/2020

Assignments, Class exercises

Space, Normed Space, Banach space,

Further Properties of Normed Spaces,

Finite Dimensional Normed spaces and

Subspaces, Compactness and Finite

19/10/2020

Lectures, Discussions
Assignments, Class exercises

Dimension

Module 2: Linear Operators, Bounded and Continuous Linear Operators, Linear

19/10/2020

exercises

Functionals, Linear Operators and

Functionals on Finite dimensional spaces,

Normed spaces of operators, Dual space

19/10/2020

Lectures, Discussions
Assignments, Class exercises

Module 3: Inner Product Space, Hilbert

19/10/2020

exercises

space, Further properties of Inner Product Space, Orthogonal Complements and

Direct Sums, Orthonormal sets and

sequences, Series related to Orthonormal

sequences and sets, Total Orthonormal sets

and sequences, Representation of

19/10/2020

Lectures, Student
Presentations, Discussions

Module 4: Hilbert-Adjoint Operator, Self-Adjoint, Unitary and Normal

19/10/2020

Operators, Von Neumann's Hahn-Banach

Theorem, Hahn-Banach Theorem for

Complex Vector Spaces and Normed

Spaces, Adjoint Operators

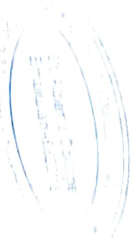
II. Innovative Learning Programmes

Name of Programme
Guest Discussion and
Duration
3 hour
Type
Research Based
Learning

Programme Time

Sit. Math
Dharmat

presentation of
challenging exercises
from the text book



III. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	20th July, 2020 Submit the assignment before 27th July, 2020
Assignment 2	Assignment on given topic	Preparation of assignment	24th August, 2020 Submit the assignment before 30th August, 2020

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

IV. Attendance (one component in class participation):

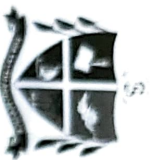
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

V. Required reading:

- Erwin Kreyzig, Introductory Functional Analysis with applications, John Wiley and sons, New York
- Limaye, B. V., Functional Analysis, New Age International (P) LTD, New Delhi, 2004
- Simmons, G.F, Introduction to Topology and Modern Analysis, McGraw –Hill, New York, 1963
- Siddiqi, A.H, Functional Analysis with Applications, Tata McGraw –Hill, New Delhi, 1989

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St. Albert's College (Autonomous)
AN ISO 9001:2015 CERTIFIED INSTITUTION
ADVANCED MATHEMATICS AND INTEGRAL TRANSFORMS

Course Instructor

Name	Sem. Programme & Batch	Email
Jeemra Jose	Sem 3 MSc. 2020-21	jeemrajose@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	6
	Total	96
Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)		6

II. Course Objectives:

- 1. Calculate partial derivatives, directional derivatives and total derivatives of multivariable functions.
- 2. Know the Mean value theorem for vector valued functions
- 3. Use the Chain Rule
- 4. Find and classify critical points of functions, using the second derivative test
- 5. Find maximum and minimum values for a function defined on a closed bounded, planar set.

III. Course Delivery Plan

This course is a course requiring lot of student culture, learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.

Topics	Session No & Dates	Methodology and Duration
These are the topics to be covered in the modules		

The Weierstrass theorem, other forms of Fourier series, the Fourier integral theorem, the exponential form of the Fourier integral theorem, integral	1 (96-2020) to 29 (96-2020)	Lectures, Problem solving
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The directional derivative, directional derivatives and continuity, the total derivative, the total derivative expressed in terms of partial derivatives. An application of complex-valued functions, the matrix of a linear function, the Jacobian matrix, the matrix form of the chain rule, implicit functions and extremum problems, the mean value theorem for differentiable functions.

30/06/2020 TO

Class exercises

Lectures
Discussions
Videos

Illustration with examples

A sufficient condition for differentiability, a sufficient condition for equality of mixed partial derivatives, functions with non-zero Jacobian determinant, the inverse function theorem, the implicit function theorem, extrema of real-valued functions of one variable, extrema of real-valued functions of several variables.

25/08/2020 TO

Lectures, Discussions,
Class exercises

04/10/2020

Integration, primitive mappings, partitions of unity, change of variables, differential forms.

5/10/2020 TO
16/11/2020

GD, Lectures, Class
exercises, Presentations by
students

III. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Visualisation of derivatives	1 Hour	Experiential Learning	1 st Week
Illustrations with examples of theorems and concepts	5 Hours	Experiential learning	2nd Week
Visualisation of examples using GEOGEBRA	3 hrs	Experiential learning	6 th week

IV. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	18th July 2020 Submit the assignment to Google Classroom before 26 th July
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	04/09/2020 to 26/09/2020 Submit the report before 2nd Sep

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained

V. Attendance (one component in class participation):



85-90%	3
80-85%	2
75-80%	1
<75	
Not eligible for appearing for ESE	

VI. Required reading:

1. Tom APOSTOL, Mathematical Analysis, Second edition, Narosa Publishing House.
2. WALTER RUDIN, Principles of Mathematical Analysis, Third edition – International Student Edition K.D Joshi, Introduction to General Topology, Wiley Eastern Ltd, 1984
3. Limaye Balnohan Vishnu, Multivariate Analysis, Springer.
4. Satish Shirali and Harkrishnan, Multivariable Analysis, Springer

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St. Albert's College (Autonomous)

PM13CRT0419 OPTIMIZATION TECHNIQUES

Course Instructor
Name

Sem, Programme & Batch

Email

Sem III MSc ,2020-21

I. Duration of Course: No Activity

Duration

1 Contact hours

90(Including assignments)

2 Assessment (CAE & ESE)

6

Total

96

Remedial Sessions/Peer Tutoring/Tutorials (need
based & Optional) 6

II.Course Objectives:

- Learn classical optimization techniques and numerical methods of optimization.
- Know the basics of different evolutionary algorithms.
- Explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.
- Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems
- Ability to go in research by applying optimization techniques in problems of Engineering and Technology.

III. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, assignments, Seminars etc.



Topics

Session No &
Date(s)

Methodology and Duration

These are the topics to be covered in the modules

Simplex Method, Canonical form of equations, Simplex Method (Numerical Example), Simplex Tableau, Finding the first BFS and artificial variables, Degeneracy, Simplex multipliers, Revised simplex method, Duality in LP, Duality theorems, Applications of Duality, Dual simplex method, Summary of simplex methods	01/06/2020 TO 08/07/2020	Class exercises Lectures Discussions Illustration with examples
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LLP in two dimensional space – General LLP, and M.LLP problems – cutting planes – remarks on cutting plane methods – branch and bound method – examples – general description – the 0 – 1 variable	09/07/2020 TO 20/08/2020	Lectures, Discussions, Class exercises
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Goal programming, Graphs- definitions and notation – minimum path problem – spanning tree of minimum length – problem of minimum potential difference – scheduling of sequential activities – maximum flow problem – duality in the maximum flow problem – generalized problem of maximum flow.	21/08/2020 TO 25/09/2020	GD, Lectures, Class exercises, Assignment.
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Basic concepts – Taylor's series expansion – Fibonacci Search - golden section search – Hooke and Jeeves search algorithm – gradient projection search – Lagrange multipliers – equality constraint optimization, constrained derivatives – non-linear optimization. Kuhn-Tucker conditions – complementary Pivot algorithms.	26/09/2020 TO 16/11/2020	GD, Lectures, Class exercises, Student Presentations
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II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Illustrations with examples of theorems and concepts	5 Hours	Experimental learning	1st Week



III. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on given topic	Preparation of assignment	25th August 2020 Submit the assignment book before 3 pm.
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	26-09-2020 TO 16-11-2020 Submit the report before 17th November 2020.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

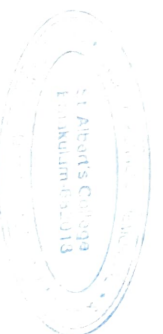
IV. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	

Not eligible for appearing for ESE

V. Required reading:

1. K. V. Mital and C. Mohan, Optimization Methods in Operation Research and Systems Analysis, 3rd edition.
2. Ravindran, Phillips and Solberg. Operations Research Principle and Practice, 2nd edition, John Wiley and Sons.
3. S.S. Rao, Optimization Theory and Applications, 2nd edition, New Age International Pvt.
4. J.K. Sharma, Operations Research: Theory and Applications, 3rd edition, Macmillan India Ltd.
5. Handy A. Thaha, Operations Research – An Introduction, 6th edition, Prentice Hall of India Pvt Ltd





St. Albert's College (Autonomous)

PMT3CRT0119 – ADVANCED COMPLEX ANALYSIS

I. Course Instructor

Name	Sem, Programme & Batch	Email
GOLDA MARY JOSEPH	Sem 3, M.Sc. Mathematics ,2020-21	goldamary@alberts.edu.in

II. Duration of Course:

No	Activity	Duration
1	Contact hours	90
2	Assessment (C/A/E & E/S)	7
	Total	97
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	7

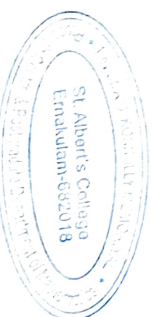
III. Course Objectives:

- Define the concept of Harmonic functions
- Present the central ideas in the solution of Dirichlet's problem
- Express concepts of convergence sequences and series of the complex functions.
- Express concepts of absolute and uniform convergence of power series.
- Define the concepts of Taylor and Laurent series.
- Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from complex analysis

IV. Course Delivery Plan

Topics	Session No & Dates)	Methodology and Duration
These are the topics to be covered in the modules		
Revision Tour		
	1/6/20	Class exercises
	2/6/20	
	3/6/20	
	4/6/20	Lectures
	5/6/20	

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Harmonic Functions – Definitions and Basic Properties, The Mean-Value Property, Poisson's Formula, Schwarz's Theorem, The Reflection Principle. A closer look at Harmonic Functions – Functions with Mean Value Property, Harnack's Principle, The Dirichlet's Problem – Subharmonic Functions, Solution of Dirichlet's Problem Power Series Expansions – Weierstrass's theorem, The Taylor Series, The Laurent Series Partial Fractions and Factorization – Partial Fractions, Infinite Products, Canonical Products, The Gamma Function, Entire Functions – Jensen's Formula, Hadamard's Theorem The Riemann Zeta Function – The Product Development, The Extension of (s) to the Whole Plane, The Functional Equation, The Zeros of the Zeta Function Normal Families – Normality and Compactness, Arzela's Theorem	08/06/20 to 07/07/20	Class exercises Lectures
The Riemann Mapping Theorem – Statement and Proof, Boundary Behaviour: Use of the Reflection Principle The Weierstrass's Theory – The Weierstrass's - function, The Differential Equation	09/10/20 to 20/11/20	Class exercises Lectures

V. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Illustration of Uniform Convergence and Point-wise Convergence using Geogebra	2hrs	Experiential Learning	2 nd week of July
Analysing equi-continuous family of functions using Geogebra	1hr	Experiential learning	1 st week of October

VI. Assignments and Seminars Assignments

The following Assignment needs to be submitted to Google Classroom. Both the assignments & presentation are individual assignments.





St. Albert's College (Autonomous)

PMT4CRT10119 – SPECTRAL THEORY

I. Course Instructor

Name	Sem, Programme & Batch	Email
Divya Mary Daise S	Sem 4, M.Sc. Mathematics, 2020-21	divyamar@alberts.edu.in

II. Duration of Course:

No	Activity	Duration
1	Contact hours	75
2	Assessment (CAE & ESE)	5
	Total	80
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	10

III. Course Objectives:

- Define and thoroughly explain Banach and Hilbert spaces and self-adjoint operators
- Independently prove and thoroughly explain central theorems like Category Theorem, Uniform Boundedness Theorem, Open Mapping Theorem, Closed Graph Theorem, Banach Fixed Point Theorem.
- Define and thoroughly explain the spectra of linear operators in finite dimensional normed spaces.
- Define and thoroughly explain the spectral properties of bounded linear operators, compact linear operators, bounded self adjoint linear operators and projection operators.

IV. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
Topics These are the topics to be covered in the modules		
Module 1: Reflexive Spaces, Category theorem(statement only), Uniform Boundedness theorem (applications excluded), Strong and Weak Convergence, Convergence of Sequences of Operators and Functionals, Open Mapping Theorem, Closed Linear Operators, Closed Graph Theorem	04-01-2021 to 15-02-2021	Lectures, Discussions, Assignments, Class exercises

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Module 2: Banach Fixed point theorem, Spectral theory in Finite Dimensional Normed Spaces, Basic Concepts, Spectral Properties of Bounded Linear Operators, Further Properties of Resolvent and Spectrum, Use of Complex Analysis in Spectral Theory	16-02-2021 to 08-03-2021	Lectures, Discussions, Assignments, Class exercises
Module 3: Banach Algebras, Further Properties of Banach Algebras, Compact Linear Operators on Normed spaces, Further Properties of Compact Linear Operators, Spectral Properties of compact Linear Operators on Normed spaces, Further Spectral Properties of Compact Linear Operators	09-03-2021 to 09-04-2021	Lectures, Discussions, Assignments, Class exercises
Module 4: Spectral Properties of Bounded Self adjoint linear operators, Further Spectral Properties of Bounded Self Adjoint Linear Operators, Positive Operators, Projection Operators, Further Properties of Projections	12-04-2021 to 30-04-2021	Lectures, Student Presentations, Discussions

V.

Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Group Discussion and presentation of challenging exercises from the text book	5 Hour	Research Based Learning	5th Week onwards

VI. Assignments and Seminars

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment 1 on given topic	Preparation of assignment	25 th February 2021 Submit the assignment before 5th March, 2020
Assignment 2	Assignment 2 on given topic	Preparation of assignment	14 th March 2021 Submit the assignment before 24 th March 2021

Note: Failure to upload the assignment to on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%

5



90-95%
 85-90%
 80-85%
 75-80%
 <75

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 3
 2
 1

Not eligible for appearing for ESE.

VIII. Required reading:

- Erwin Kreyszig, Introductory Functional Analysis with applications, John Wiley and sons, New York
- Limaye, B. V, Functional Analysis, New Age International (P) LTD, New Delhi, 2004
- Simmons, G.F, Introduction to Topology and Modern Analysis, McGraw –Hill, New York, 1963
- Siddiqi, A.H, Functional Analysis with Applications, Tata McGraw –Hill, New Delhi, 1989
- Somasundaram, D, Functional Analysis, S. Viswanathan Pvt. Ltd, Madras, 1994
- Vasistha, A.R and Sharma I.N, Functional analysis, Krishnan Prakashan Media (P) Ltd, Meerut: 1995-96
- M. Thamban Nair, Functional Analysis, A First Course, Prentice – Hall of India Pvt. Ltd, 2008
- Walter Rudin, Functional Analysis, TMH Edition, 1974.



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St. Albert's College (Autonomous)

PMT2CRT0319 - Numerical Analysis with Python3

Course Instructor

Name
Divya Mary Daise S

Sem, Programme & Batch
Sem 2 M Sc, 2020-21

Email
divyamary@alberts.edu.in

I. Duration of Course:

No	Activity	Duration
1	Contact hours	75(Including assignments and Lab)
2	Assessment (CAE & ESE)	5
	Total	90
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	10

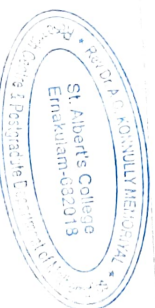
II. Course Objectives:

- To understand the basics of Python3
- To familiarise the SymPy module
- To learn about doing calculus with SymPy
- To know about interpolation and rootsearch using Python3
- To learn about Solving system of equations and numerical integration using Python3

III. Course Delivery Plan

The teaching methods include lectures, discussions, assignments, Seminars etc.

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
An introduction to Python: Calculations and variables, creating strings, lists are more powerful than strings, tuples, If and statements, if-then-else statements, if and		Lecture, Discussions, Practical Sessions, Programming Challenges



elif statements, combining conditions, the difference between strings and numbers, using for loops, while we are talking about looping, using functions, parts of a function, using modules, The functions abs, float, int, len, max, min, range, sum, complex numbers

Module 1: Defining Symbols and Symbolic Operations, Working with Expressions, Solving Equations and Plotting Using SymPy, problems on factor finder, summing a series and solving single variable inequalities

Module 2: Finding the limit of functions, finding the derivative of functions, higher-order derivatives and finding the maxima and minima and finding the integrals of functions are to be done. in the section programming challenges, the following problems - verify the continuity of a function at a point, area between two curves and finding the length of a curve

Module 3: Interpolation and Curve Fitting - Polynomial Interpolation - Lagrange's Method, Newton's Method and Limitations of Polynomial Interpolation,

Roots of Equations - Method of Bisection and Newton-Raphson Method.

Module 4: Gauss Elimination Method (excluding Multiple Sets of Equations), Doolittle's Decomposition Method only from LU Decomposition Methods

Numerical Integration, Newton-Cotes Formulas, Trapezoidal rule, Simpson's rule and Simpson's 3/8 rule.

Lecture, Discussions, Practical Sessions, Programming Challenges, Student Presentations

Lecture, Discussions, Practical Sessions, Programming Challenges, Student Presentations

Lecture, Discussions, Practical Sessions, Programming Challenges, Student Presentations

Lecture, Discussions, Practical Sessions, Programming Challenges, Student Presentations

II. Innovative Learning Programmes

Name of Programme	Duration	Type
Group Discussion and presentation of challenging programs from the text book	5 Hour	Research Based Learning

Proposed Time
5th Week
onwards





Journey to Origin - Do literature review and do a presentation (of 15 minutes) about the origins and most common uses of the Python Language

Literature Review/Flipped Learning

8th Week onwards

III. Assignments and Seminars

No	Topics	Activity	Submission Deadlines	
Assignment 1	Assignment on given topic	Preparation of assignment		
Assignment 2	Assignment on given topic	Preparation of assignment		

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

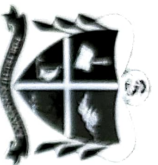
IV. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

V. Required reading:

- Jason R Brigs . Python for kids – a playful introduction to programming, No Starch Press
- Armit Saha, Doing Math with Python, No Starch Press, 2015.
- Jaan Kiusalas, Numerical Methods in Engineering with Python3, Cambridge University Press.



St. Albert's College (Autonomous)

PMTZCRJ01516 - Measure Theory and Integration

Course Instructor
Name

Sem, Programme & Batch

Email

Sem 2 M.Sc. 2020-21

I. Duration of Course:

No Activity

Duration

1 Contact hours

5 (Including assignments)

2 Assessment (CAE & ESE)

5

Total

90

Remedial Sessions/ Peer Tutoring/ Tutorials (need based & Optional) 10

II. Course Objectives:

- To understand the concept of Lebesgue Measure
- To learn/analyse the concepts of Lebesgue Measurable Functions and Lebesgue Integration
- To learn about General Measure Space Measurable Functions and Integration over General Measure Space
- To know about Signed Measures
- To learn about Product Measures

III. Course Delivery Plan

The teaching methods include lectures, discussions, assignments, Seminars etc.
Topics Sessions No & Methodology and Duration (Periods)

These are the topics to be covered in the modules

Module 1: Lebesgue Measure

Introduction, Lebesgue outer measure, The algebra of Lebesgue measurable sets, Additivity and inner approximation of Lebesgue measurable sets, Countable additivity, continuity and Borel-Cantelli Lemma - Non measurable sets - The Cantor set and Cantor Lebesgue function

Lectures, Discussions,
Assignments, Class
exercises





St. Albert's College (Autonomous)

PMT2CRT0519 - Measure Theory and Integration

Course Instructor

Name	Sem, Programme & Batch	Email
	Sem 2 M Sc ,2020-21	

I. Duration of Course:

No	Activity	Duration
1	Contact hours	75(Including assignments)
2	Assessment (CAE & ESE)	5
	Total	90
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	10

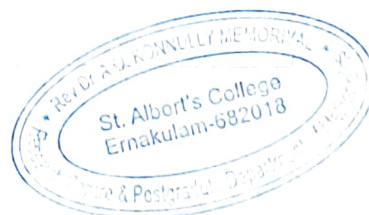
II.Course Objectives:

- To understand the concept of Lebesgue Measure
- To familiarise the concepts Lebesgue Measurable Functions and Lebesgue Integration
- To learn about General Measure Space, Measureable Functions and Integration over General Measure Space
- To know about Signed Measures
- To learn about Product Measures

III. Course Delivery Plan

The teaching methods include lectures, discussions, assignments, Seminars etc.

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Module 1: Lebesgue Measure: Introduction, Lebesgue outer measure, The algebra of Lebesgue measurable sets, Outer and inner approximation of Lebesgue measurable sets , Countable additivity, continuity and Borel-Cantelli Lemma - Non measureable sets - The Cantor set and Cantor Lebesgue function		Lectures, Discussions, Assignments, Class exercises



Module 2: Lebesgue Measurable Functions and Lebesgue Integration: Sums, products and compositions – Sequential pointwise limits and simple approximation – The Riemann Integral – The Lebesgue integral of a bounded measurable function over a set of finite measure – The Lebesgue integral of a measurable non negative function – The general Lebesgue integral.

Lectures, Discussions, Assignments, Class exercises

Module 3: General Measure Space and Measureable Functions: Measures and measurable sets – Signed Measures: The Hanh and Jordan decompositions – The Caratheodory measure induced by an outer measure – Measureable functions

Lectures, Discussions, Assignments, Class exercises

Module 4: Integration over General Measure Space and Product Measures: Integration of non negative measurable functions – Integration of general measurable functions – The Radon Nikodym Theorem – Product measure: The theorems of Fubini and Tonelli

Lectures, Student Presentations, Discussions

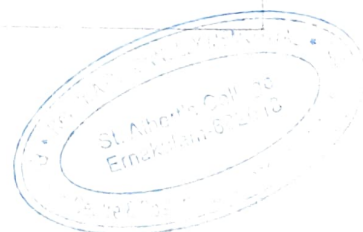
II. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Group Discussion and presentation of challenging exercises from the text book	5 Hour	Research Based Learning	5th Week onwards
Know The Genius - Do literature review and do a presentation (of 15 minutes) about the famous mathematicians involved in the area of study	4 Hours	Literature Review/Flipped Learning	8th Week onwards

III. Assignments and Seminars

Assignments

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	



Assignment 2	Assignment	Preparation
	on given	of
	topic	assignment

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission are entertained.

IV. Attendance (one component in class participation):

90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

V. Required reading:

H. L. Royden, P.M. Fitzpatrick, Real Analysis Fourth Edition, Pearson Education
 G. de Barra : Measure Theory and integration , New Age International (P) Ltd., New Delhi
 New Age International (P) Ltd., New Delhi.
 Halmos P.R, Measure Theory, D.vanNostrand Co.
 P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Ltd., New Delhi, 1986(Reprint 2000).
 R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc New York, 1966.

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PMT4CRT0419 – OPERATIONS RESEARCH

I. Course Instructor

Name	Sem, Programme & Batch	Email
GOLDA MARY JOSEPH	Sem 4, M.Sc. Mathematics, 2020-21	goldamary@alberts.edu.in

II. Duration of Course:

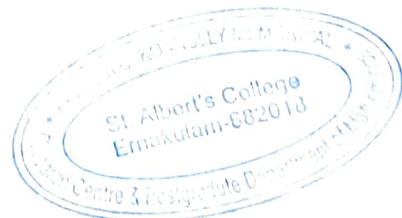
No	Activity	Duration
1	Contact hours	75
2	Assessment (CAE & ESE)	7
	Total	82
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	8

III. Course Objectives:

- Identify the use of Dynamic Programming Models
- Acquire a working knowledge of queuing models, a description of the underlying theory and examples of their applications in the area of communication and transport
- Describe and explain the theory of Markov Chains describe and motivate Little's formula and its applications
- Understand the concept of EOQ models and its types
- Design a continuous or periodic review inventory-control system.
- Provide an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in computer applications - Skill Development

IV. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
Topics These are the topics to be covered in the modules	Session No & Date(s)	Methodology and Duration
Dynamic Programming Introduction , Problem 1- Minimum path problem. Problem 2 -Single additive constraint, additively separable return. Problem 3-	04-01-2021 to 15-02-2021	Class exercises Lectures



Single multiplicative constraint, additively separable return, Problem 4- Single additive constraint, multiplicatively separable return, Computational economy in DP, Serial multistage model, Examples of failure, Decomposition, Backward and forward recursion, Systems with more than one constraints, Applications of D.P to continuous systems.

Continuous time random processes An example, Formal definitions and theory, the assumptions reconsidered, Steady state probabilities, Birth death processes, The Poisson process.

16-02-2021 to
08-03-2021

Class exercises

Lectures

Queueing Systems Introduction, An example, General Characteristics, Performance Measures, Relations Among the performance Measures, Markovian Queueing Models, The M/M/1 Model, Limited Queue Capacity, Multiple Servers, An example, Finite Sources.

09-03-2021 to
09-04-2021

Class exercises

Lectures

Inventory Models Introduction The classical Economic Order Quantity, A Numerical example, Sensitivity Analysis, Non Zero lead Time, The EOQ, with shortages allowed The Production Lot size (PLS) models, The Newsboy Problem (a single period model), A Lot size reorder point model, Variable lead times, The importance of selecting the right model.

12-04-2021 to
30-04-2021

Class exercises

Lectures

V.

Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
SOLUTION OF DPP USING EXCEL	1 Week	Skill Development	3 rd week of January
Optimization using – TORA(Temporary Ordered Routing Algorithm)	1 Day	Experiential learning	4 th Week of April

VI. Assignments and Seminars

Assignments

The following Assignment needs to be submitted to Google Classroom.

No	Topics	Activity	Submission Deadlines
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Assignment	Assignment on given topic	Preparation of assignment	Assignment 1 : 25 th February 2021 Assignment 2 : 4 th March 2021 Assignment 3 : 22 nd March 2021. Assignment 4: 18 th April 2021 3 rd and 4 th Week of April	Submit the assignment to Google Classroom before 11.59 pm Submit the report 2 days before the seminar
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 10 - 15 minutes duration		

Note: Failure to upload the assignment to Google Classroom on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

VIII. Required reading:

1. K.V. Mital and C. Mohan, Optimization Methods in Operations Research and System Analysis, 3rd edition, New Age International Pvt. Ltd..
2. A. Ravindran, Don T. Philips and James J. Solberg., Operations Research Principles and Practice, 2nd edition, John Wiley and Sons.
3. Fundamentals of Queueing Theory, Donald Gross, Carl M. Harris, 3rd edition, John Wiley and Sons.
4. Hamdy A. Taha, Operations Research – An Introduction, 6th edition, Prentice Hall of India Pvt. Ltd.
5. Man Mohan, P.K. Gupta and Kanti Swarup, Operations Research, Sultan Chand and Sons.

(Signature)





St. Albert's College (Autonomous)

PMT4CRT0219 – ANALYTIC NUMBER THEORY

1. Course Instructor

Name	Sem, Programme & Batch	Email
Jeema Jose	Sem 4, M.Sc. Mathematics, 2020-21	jeemajose@alberts.edu.in

I. Duration of Course:

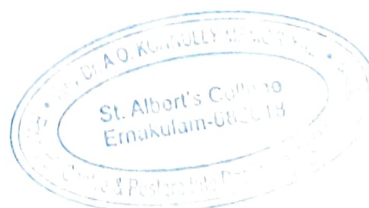
No	Activity	Duration
1	Contact hours	90
2	Assessment (CAE & ESE)	7
	Total	97
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	8

II. Course Objectives:

- Obtain a knowledge about various arithmetical functions such as the Möbius function $\mu(n)$, the Euler totient function $\phi(n)$, the Mangoldt function $\Lambda(n)$, Liouville's function $\lambda(n)$, The divisor function $\sigma\alpha(n)$,...
- To know the relation between these functions and properties of these functions
- Finding Dirichlet product of two arithmetical functions and familiar with generalized convolution
- Obtain an idea about Big Oh function and asymptotically equivalent functions
- Counting prime numbers not exceeding a given number.
- To know prime number theorem and different equivalent conditions of prime number theorem
- To know congruence relations and solving a system of congruence relations
- Understand the properties of congruence relations
- Describe residue classes and reduced residue classes
- Finding quadratic residues and quadratic nonresidues
- Familiar with Legendre symbol and finding the value of Legendre symbol
- To know Gauss lemma, reciprocity law and applications of these results.

III. Course Delivery Plan

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Arithmetic Functions, Dirichlet Multiplication and Averages of Arithmetical functions	04-01-2021 to 18-02-2021	Class exercises
Arithmetic Functions, Dirichlet		Lectures



Multiplication: Introduction. The Möbius function $\mu(n)$. The Euler totient function $\phi(n)$, a relation connecting μ and ϕ , a product formula for $\phi(n)$. The Dirichlet product of arithmetical functions, Dirichlet inverses and the Möbius inversion formula. The Mangoldt function $\Lambda(n)$. Multiplicative functions, Multiplicative functions and Dirichlet Multiplication. The inverse of a completely multiplicative function. The Liouville's function $\lambda(n)$. The divisor function $\sigma(n)$. Generalized convolutions Averages of Arithmetical functions: Introduction, The big oh notation. Asymptotic equality of functions. Euler's summation formula. Some elementary asymptotic formulas. The average order of $d(n)$. The average order of the divisor functions $\sigma(n)$. The average order of $\phi(n)$. An application to the distribution of lattice points visible from the origin. The average order of $\mu(n)$ and of $\Lambda(n)$. The partial sums of a Dirichlet product. Applications to $\mu(n)$ and of $\Lambda(n)$.

Discussions
Problem Solving sessions

Some Elementary Theorems on the Distribution of Prime Numbers Introduction, Chebyshev's functions $\psi(x)$ and $\vartheta(x)$, Relation connecting $\vartheta(x)$ and $\pi(x)$, Some equivalent forms of the prime number theorem, Inequalities for $\pi(n)$ and P_n . Shapiro's tauberian theorem. Applications of Shapiro's theorem. An asymptotic formula for the partial sum $\sum 1/p$

19-02-2021 to
08-03-2021

Class exercises
Lectures

Congruences: Definitions and basic properties of congruences. Residue classes and complete residue system. Linear congruences, Reduced residue systems and Euler-Fermat theorem. Polynomial congruences modulo p , Lagrange's theorem, Applications of Lagrange's theorem, Simultaneous linear congruences, The Chinese remainder theorem, Applications of the Chinese remainder theorem.

09-03-2021 to
09-04-2021

Discussions,
Student presentations
Class exercises
Lectures
Problem solving sessions

Quadratic Residues, The Quadratic Reciprocity Law and Primitive Roots, Quadratic Residues, The Quadratic Reciprocity Law: Quadratic residues. Legendre's symbol and its properties, evaluation of $(-1/p)$ and $(2/p)$, Gauss' Lemma, The quadratic reciprocity law, Applications of the reciprocity law. (Chapter 9: 9.1 to 9.6) Primitive Roots: The exponent of a number mod m , Primitive roots, Primitive roots and reduced residue systems, The nonexistence of primitive roots mod 2α for $\alpha \geq 3$, The existence of primitive root mod p for odd primes p . Primitive roots and quadratic residues..

12-04-2021 to
30-04-2021

Class exercises
Discussions
Lectures
Problem solving sessions



IV.

Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Problem solving sessions	1 Week	Skill Development	2nd week of March
Problem solving sessions	1 day	Skill development	April

V. Assignments and Seminars

Assignments

The following Assignment needs to be submitted to Google Classroom.

No	Topics	Activity	Submission Deadlines
Assignment 1	Assignment on given topic	Preparation of assignment	Submit the assignment to Google Classroom before 11.00 pm
			Assignment 1 : 4 th March 2021
			Assignment 2: Submit the assignment through whats app
			18 th April 2021
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 30 minutes duration	2 nd , 3 rd and 4 th Week of April
			Submit the report 2 days before the seminar

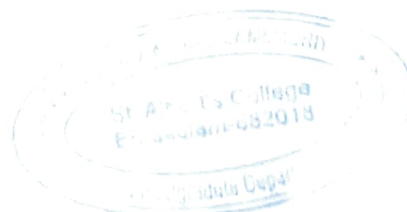
Note: Failure to upload the assignment to Google Classroom on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VI. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

VII. Required reading:

- 1 Tom M. Apostol, Introduction to Analytic Number Theory, Springer International Student Edition, Narosa Publishing House
- 2 David M. Burton, Elementary number Theory, Seventh edition, Tata McGraw-Hill Edition 2012
- 3 Kenneth H. Rosen, Elementary Number Theory and its Applications, sixth edition, 2011
- 4 Hardy G.H. and Wright E.M., Introduction to the Theory of Numbers, Oxford, 1981
- 5 Leveque W.J., Topics in Number Theory, Addison Wesley, 1961.
- 6 J.P. Serre, A Course in Arithmetic, GTM Vol.7, Springer-Verlag, 1973





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1900/1901/1902/1903/1904/1905/1906/1907/1908/1909/1910/1911/1912/1913/1914/1915/1916/1917/1918/1919/1920/1921/1922/1923/1924/1925/1926/1927/1928/1929/1930/1931/1932/1933/1934/1935/1936/1937/1938/1939/1940/1941/1942/1943/1944/1945/1946/1947/1948/1949/1950/1951/1952/1953/1954/1955/1956/1957/1958/1959/1960/1961/1962/1963/1964/1965/1966/1967/1968/1969/1970/1971/1972/1973/1974/1975/1976/1977/1978/1979/1980/1981/1982/1983/1984/1985/1986/1987/1988/1989/1990/1991/1992/1993/1994/1995/1996/1997/1998/1999/2000/2001/2002/2003/2004/2005/2006/2007/2008/2009/2010/2011/2012/2013/2014/2015/2016/2017/2018/2019/2020/2021/2022/2023/2024/2025/2026/2027/2028/2029/2030/2031/2032/2033/2034/2035/2036/2037/2038/2039/2040/2041/2042/2043/2044/2045/2046/2047/2048/2049/2050/2051/2052/2053/2054/2055/2056/2057/2058/2059/2060/2061/2062/2063/2064/2065/2066/2067/2068/2069/2070/2071/2072/2073/2074/2075/2076/2077/2078/2079/2080/2081/2082/2083/2084/2085/2086/2087/2088/2089/2090/2091/2092/2093/2094/2095/2096/2097/2098/2099/2100/2101/2102/2103/2104/2105/2106/2107/2108/2109/2110/2111/2112/2113/2114/2115/2116/2117/2118/2119/2120/2121/2122/2123/2124/2125/2126/2127/2128/2129/2130/2131/2132/2133/2134/2135/2136/2137/2138/2139/2140/2141/2142/2143/2144/2145/2146/2147/2148/2149/2150/2151/2152/2153/2154/2155/2156/2157/2158/2159/2160/2161/2162/2163/2164/2165/2166/2167/2168/2169/2170/2171/2172/2173/2174/2175/2176/2177/2178/2179/2180/2181/2182/2183/2184/2185/2186/2187/2188/2189/2190/2191/2192/2193/2194/2195/2196/2197/2198/2199/2200/2201/2202/2203/2204/2205/2206/2207/2208/2209/2210/2211/2212/2213/2214/2215/2216/2217/2218/2219/2220/2221/2222/2223/2224/2225/2226/2227/2228/2229/2230/2231/2232/2233/2234/2235/2236/2237/2238/2239/2240/2241/2242/2243/2244/2245/2246/2247/2248/2249/2250/2251/2252/2253/2254/2255/2256/2257/2258/2259/2260/2261/2262/2263/2264/2265/2266/2267/2268/2269/2270/2271/2272/2273/2274/2275/2276/2277/2278/2279/2280/2281/2282/2283/2284/2285/2286/2287/2288/2289/2290/2291/2292/2293/2294/2295/2296/2297/2298/2299/2300/2301/2302/2303/2304/2305/2306/2307/2308/2309/2310/2311/2312/2313/2314/2315/2316/2317/2318/2319/2320/2321/2322/2323/2324/2325/2326/2327/2328/2329/2330/2331/2332/2333/2334/2335/2336/2337/2338/2339/2340/2341/2342/2343/2344/2345/2346/2347/2348/2349/2350/2351/2352/2353/2354/2355/2356/2357/2358/2359/2360/2361/2362/2363/2364/2365/2366/2367/2368/2369/2370/2371/2372/2373/2374/2375/2376/2377/2378/2379/2380/2381/2382/2383/2384/2385/2386/2387/2388/2389/2390/2391/2392/2393/2394/2395/2396/2397/2398/2399/2400/2401/2402/2403/2404/2405/2406/2407/2408/2409/2410/2411/2412/2413/2414/2415/2416/2417/2418/2419/2420/2421/2422/2423/2424/2425/2426/2427/2428/2429/2430/2431/2432/2433/2434/2435/2436/2437/2438/2439/2440/2441/2442/2443/2444/2445/2446/2447/2448/2449/2450/2451/2452/2453/2454/2455/2456/2457/2458/2459/2460/2461/2462/2463/2464/2465/2466/2467/2468/2469/2470/2471/2472/2473/2474/2475/2476/2477/2478/2479/2480/2481/2482/2483/2484/2485/2486/2487/2488/2489/2490/2491/2492/2493/2494/2495/2496/2497/2498/2499/2500/2501/2502/2503/2504/2505/2506/2507/2508/2509/2510/2511/2512/2513/2514/2515/2516/2517/2518/2519/2520/2521/2522/2523/2524/2525/2526/2527/2528/2529/2530/2531/2532/2533/2534/2535/2536/2537/2538/2539/2540/2541/2542/2543/2544/2545/2546/2547/2548/2549/2550/2551/2552/2553/2554/2555/2556/2557/2558/2559/2560/2561/2562/2563/2564/2565/2566/2567/2568/2569/2570/2571/2572/2573/2574/2575/2576/2577/2578/2579/2580/2581/2582/2583/2584/2585/2586/2587/2588/2589/2590/2591/2592/2593/2594/2595/2596/2597/2598/2599/2600/2601/2602/2603/2604/2605/2606/2607/2608/2609/2610/2611/2612/2613/2614/2615/2616/2617/2618/2619/2620/2621/2622/2623/2624/2625/2626/2627/2628/2629/2630/2631/2632/2633/2634/2635/2636/2637/2638/2639/2640/2641/2642/2643/2644/2645/2646/2647/2648/2649/2650/2651/2652/2653/2654/2655/2656/2657/2658/2659/2660/2661/2662/2663/2664/2665/2666/2667/2668/2669/2670/2671/2672/2673/2674/2675/2676/2677/2678/2679/2680/2681/2682/2683/2684/2685/2686/2687/2688/2689/2690/2691/2692/2693/2694/2695/2696/2697/2698/2699/2700/2701/2702/2703/2704/2705/2706/2707/2708/2709/2710/2711/2712/2713/2714/2715/2716/2717/2718

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1



1. *Chlorophyll a* (Chl a) and *Chlorophyll b* (Chl b) are the primary photosynthetic pigments in green plants. They are responsible for capturing light energy and converting it into chemical energy through the process of photosynthesis. Chl a is the most abundant pigment, while Chl b is present in smaller amounts. Both pigments absorb light most efficiently in the blue and red regions of the visible spectrum.

- [illegible]

1. *Chlorophyll a* and *Chlorophyll b* content of the leaves of *Chlorella* sp. and *Chlorella* sp. were determined by spectrophotometry.

Figure 1

1. Explain the importance of the following factors in the development of a country's economy:  
 (a) Human Resources  
 (b) Capital Resources  
 (c) Technology  
 (d) Infrastructure  
 (e) Government Policy  
 (f) International Trade  
 (g) Investment  
 (h) Education  
 (i) Healthcare  
 (j) Environment  
 (k) Democracy  
 (l) Corruption  
 (m) Religion  
 (n) Culture  
 (o) Language  
 (p) History  
 (q) Geography  
 (r) Climate  
 (s) Disaster  
 (t) War  
 (u) Peace  
 (v) Stability  
 (w) Unity  
 (x) Cooperation  
 (y) Competition  
 (z) Innovation  
 (aa) Research  
 (ab) Development  
 (ac) Growth  
 (ad) Progress  
 (ae) Success  
 (af) Failure  
 (ag) Challenge  
 (ah) Opportunity  
 (ai) Risk  
 (aj) Reward  
 (ak) Effort  
 (al) Perseverance  
 (am) Patience  
 (an) Confidence  
 (ao) Self-belief  
 (ap) Optimism  
 (aq) Pessimism  
 (ar) Realism  
 (as) Idealism  
 (at) Pragmatism  
 (au) Humanism  
 (av) Capitalism  
 (aw) Socialism  
 (ax) Communism  
 (ay) Democracy  
 (az) Authoritarianism  
 (ba) Monarchy  
 (bb) Republic  
 (bc) Dictatorship  
 (bd) Constitution  
 (be) Law  
 (bf) Justice  
 (bg) Equality  
 (bh) Freedom  
 (bi) Security  
 (bj) Peace  
 (bk) War  
 (bl) Stability  
 (bm) Unity  
 (bn) Cooperation  
 (bo) Competition  
 (bp) Innovation  
 (bq) Research  
 (br) Development  
 (bs) Growth  
 (bt) Progress  
 (bu) Success  
 (bv) Failure  
 (bw) Challenge  
 (bx) Opportunity  
 (by) Risk  
 (bz) Reward  
 (ca) Effort  
 (cb) Perseverance  
 (cc) Patience  
 (cd) Confidence  
 (ce) Self-belief  
 (cf) Optimism  
 (cg) Pessimism  
 (ch) Realism  
 (ci) Idealism  
 (cj) Pragmatism  
 (ck) Humanism  
 (cl) Capitalism  
 (cm) Socialism  
 (cn) Communism  
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 (cp) Authoritarianism  
 (cq) Monarchy  
 (cr) Republic  
 (cs) Dictatorship  
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 (cu) Law  
 (cv) Justice  
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 (dc) Unity  
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 (df) Innovation  
 (dg) Research  
 (dh) Development  
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 (fa) Success  
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 (gm) Research  
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 (gq) Success  
 (gr) Failure  
 (gs) Challenge  
 (gt) Opportunity  
 (gu) Risk  
 (gv) Reward  
 (gw) Effort  
 (gx) Perseverance  
 (gy) Patience  
 (gz) Confidence  
 (ha) Self-belief  
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 (hl) Authoritarianism  
 (hm) Monarchy  
 (hn) Republic  
 (ho) Dictatorship  
 (hp) Constitution  
 (hq) Law  
 (hr) Justice  
 (hs) Equality  
 (ht) Freedom  
 (hu) Security  
 (hv) Peace  
 (hw) War  
 (hx) Stability  
 (hy) Unity  
 (hz) Cooperation  
 (ia) Competition  
 (ib) Innovation  
 (ic) Research  
 (id) Development  
 (ie) Growth  
 (if) Progress  
 (ig) Success  
 (ih) Failure  
 (ii) Challenge  
 (ij) Opportunity  
 (ik) Risk  
 (il) Reward  
 (im) Effort  
 (in) Perseverance  
 (io) Patience  
 (ip) Confidence  
 (iq) Self-belief  
 (ir) Optimism  
 (is) Pessimism  
 (it) Realism  
 (iu) Idealism  
 (iv) Pragmatism  
 (iw) Humanism  
 (ix) Capitalism  
 (iy) Socialism  
 (iz) Communism  
 (ja) Democracy  
 (jb) Authoritarianism  
 (jc) Monarchy  
 (jd) Republic  
 (je) Dictatorship  
 (jf) Constitution  
 (jg) Law  
 (jh) Justice  
 (ji) Equality  
 (jj) Freedom  
 (jk) Security  
 (jl) Peace  
 (jm) War  
 (jn) Stability  
 (jo) Unity  
 (jp) Cooperation</

### Methodology and Duration

There are five regions in the country in the mountains.

*[Faint handwritten notes]*

1840 71 100  
1850 71 100

1. Explain the importance of the following factors in the development of a country's economy:

3



Multiplication Introduction. The Möbius function  $\mu(n)$ . The Euler totient function  $\phi(n)$ , a relation connecting  $\mu$  and  $\phi$ , a product formula for  $\phi(n)$ . The Dirichlet product of arithmetical functions. Dirichlet inverses and the Möbius inversion formula. The Mangoldt function  $\Lambda(n)$ . Multiplicative functions. Multiplicative functions and Dirichlet Multiplication. The inverse of a completely multiplicative function. The Liouville's function  $\lambda(n)$ . The divisor function  $\sigma(n)$ . Generalized convolutions Averages of Arithmetical functions Introduction. The big oh notation. Asymptotic equality of functions. Fulers summation formula. Some elementary asymptotic formulas. The average order of  $d(n)$ . The average order of the divisor functions  $\sigma_k(n)$ . The average order of  $\phi(n)$ . An application to the distribution of lattice points visible from the origin. The average order of  $\mu(n)$  and of  $\Lambda(n)$ . The partial sums of a Dirichlet product. Applications to  $\mu(n)$  and of  $\Lambda(n)$ .

Some Elementary Theorems on the Distribution of Prime Numbers Introduction. Chebyshev's functions  $\theta(x)$  and  $\psi(x)$ . Relation connecting  $\theta(x)$  and  $\psi(x)$ . Some equivalent forms of the prime number theorem. Inequalities for  $\pi(n)$  and  $P_n$ . Shapiro's tauberian theorem. Applications of Shapiro's theorem. An asymptotic formula for the partial sum  $\sum_{p \leq x} 1/p$

Congruences: Definitions and basic properties of congruences. Residue classes and complete residue system. Linear congruences. Reduced residue systems and Euler-Fermat theorem Polynomial congruences modulo  $p$ . Lagrange's theorem. Applications of Lagrange's theorem. Simultaneous linear congruences. The Chinese remainder theorem. Applications of the Chinese remainder theorem. Quadratic Residues: The Quadratic Reciprocity Law and Primitive Roots. Quadratic Residues: The Quadratic Reciprocity Law. Quadratic residues. Legendre's symbol and its properties. evaluation of  $(-1/p)$  and  $(2/p)$ . Gauss' Lemma. The quadratic reciprocity law. Applications of the reciprocity law (Chapter 9: 9.1 to 9.6). Primitive Roots: The exponent of a number mod  $m$ . Primitive roots. Primitive roots and reduced residue systems. The nonexistence of primitive roots mod  $2a$  for  $a \geq 3$ . The existence of primitive root mod  $p$  for odd primes  $p$ . Primitive roots and quadratic residues...

Discussions  
Problem Solving sessions

19-02-2021 to  
08-03-2021

Class exercises

Lectures

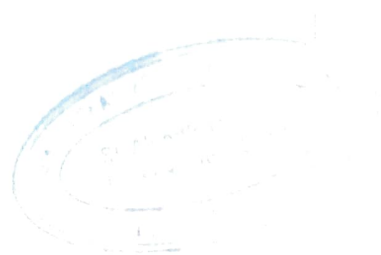
09-03-2021 to  
09-04-2021

Discussions,  
Student presentations  
Class exercises  
Lectures  
Problem solving sessions

12-04-2021 to  
30-04-2021

Class exercises  
Discussions  
Lectures  
Problem solving sessions

8



#### IV.

#### Innovative Learning Programmes

| Name of Programme        | Duration | Type              | Proposed Time     |
|--------------------------|----------|-------------------|-------------------|
| Problem solving sessions | 1 Week   | Skill Development | 2nd week of March |
| Problem solving sessions | 1 day    | Skill development | April             |

#### V. Assignments and Seminars

##### Assignments

The following Assignment needs to be submitted to Google Classroom.

| No         | Topics                                 | Activity                                                          | Submission Deadlines                                                                   |                                                                                                      |
|------------|----------------------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Assignment | Assignment on given topic              | Preparation of assignment                                         | Assignment 1 : 4 <sup>th</sup> March 2021<br>Assignment 2: 18 <sup>th</sup> April 2021 | Submit the assignment to Google Classroom before 11.00 pm<br>Submit the assignment through whats app |
| Seminar    | PowerPoint presentation on given topic | PowerPoint Presentation for a presentation of 30 minutes duration | 2 <sup>nd</sup> , 3 <sup>rd</sup> and 4 <sup>th</sup> Week of April                    | Submit the report 2 days before the seminar                                                          |

*Note: Failure to upload the assignment to Google Classroom on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.*

#### VI. Attendance (one component in class participation):

|         |                                    |
|---------|------------------------------------|
| 95-100% | 5                                  |
| 90-95%  | 4                                  |
| 85-90%  | 3                                  |
| 80-85%  | 2                                  |
| 75-80%  | 1                                  |
| <75     | Not eligible for appearing for ESE |

#### VII. Required reading:

- 1 Tom M. Apostol, Introduction to Analytic Number Theory, Springer International Student Edition, Narosa Publishing House
2. David M. Burton, Elementary number Theory, Seventh edition, Tata McGraw-Hill Edition 2012
3. Kenneth H. Rosen, Elementary Number Theory and its Applications, sixth edition, 2011
4. Hardy G.H. and Wright E.M., Introduction to the Theory of Numbers, Oxford, 1981
5. Leveque W.J., Topics in Number Theory, Addison Wesley, 1961.
6. J.P. Serre, A Course in Arithmetic, GTM Vol. 7, Springer-Verlag, 1973.

