SHIVAJI UNIVERSITY, KOLHAPUR

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CHOICE BASED CREDIT SYSTEM

Syllabus For

B.Sc. Part -III Mathematics

SEMESTER V AND VI

(Syllabus to be implemented from June, 2020 onwards.)

B.Sc.Part-III [Semester V] (Credit - 8]

Course code	Title o the course	Instructions Lectures /Week	Duration of term end exam	Marks of Term end exam	Marks (Internal) Of Continuous Assessment	Credit
DSE E9	Mathematical Analysis	3	2 hours	40	10	2
DSE E10	Abstract Algebra	3	2 hours	40	10	2
DSE E11	Optimization Techniques	3	2 hours	40	10	2
DSE E12	Integral Transforms	3	2 hours	40	10	2

B.Sc.Part-III [Semester VI] (Credit - 8]

Course code	Title o the course	Instructions Lectures/Week	Duration of term end exam	Marks Term end exam	Marks (Internal) Of Continuous Assessment	Credit
DSE F9	Metric Spaces	3	2 hours	40	10	2
DSE F10	Linear Algebra	3	2 hours	40	10	2
DSE F11	Complex Analysis	3	2 hours	40	10	2
DSE F12	Discrete Mathematics	3	2 hours	40	10	2

Core Course Practical in Mathematics [CCPM IV to VII]

The practical examination will be conducted at the end of second term that is annual pattern

Total Credit 16

Course code	Title o the course	Instructions Lectures/Week	Duration of term end exam	Marks [End of academic year]	Credit
CCPM IV	Operations Research	5	6 hours	50	4
CCPM V	Laplace and Fourier Transforms	5	6 hours	50	4
CCPM VI	Mathematical Computation Using Python	5	6 hours	50	4
CCPM VII	Project, sturdy tour, viva.	5	6 hours	50	4

EQIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS (FOR REVISED SYLLABUS

Sem - V

Old Paper number	Equivalence	New Course code	Title of the course
IX	Real Analysis	DSE E9	Mathematical Analysis
X	Abstract Algebra	DSE E10	Abstract Algebra
XII	Numerical Methods - I	DSE E11	Optimization Techniques
XI	Partial Differential Equations	DSE E12	Integral Transforms

Sem - VI

Old Paper number	Equivalence	New Course code	Title of the course
XIII	Metric spaces	DSE F9	Metric Spaces
XIV	Linear Algebra	DSE F10	Linear Algebra
XV	Complex Analysis	DSE F11	Complex Analysis
XVI	Numerical Methods	DSE F12	Discrete Mathematics

CCPM

Old course code	Equivalence	New Course code	Title of the course
CML – IV	Operations Research Techniques	CCPM IV	Operations Research
CML – V	Numerical Methods	CCPM V	Laplace and Fourier Transforms
CML – VI	Numerical Recipes in C++, SciLab	CCPM VI	Mathematical Computation Using Python
CML – VII	Project, study tour, viva.	CCPM VII	Project, study tour, Seminar, viva.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – E9 **Title of Course: Mathematical Analysis**
Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course Objectives: The objectives of course is to understand and learn about

1. The integration of bounded function on a closed and bounded interval
2. Some of the families and properties of Riemannintegrablefunctions
3. The applications of the fundamental theorems of integration
4. Extension of Riemann integral to the improper integrals when either the interval of integration is infinite or the integrand has infinite limits at a finite number of pointson the interval of integration
5. The expansion of functions in Fourier series and half range Fourier series

Unit -1 : Riemann Integration (16 hours)

Definition of Riemann integration, Inequalities for lower and upper Darboux sums, Necessary and sufficient conditions for Riemann integrability, Definition of Riemann integration by Riemann sum and equivalence of the two definitions, Riemann integrability of monotonic functions and continuous functions, Algebra and properties of Riemann integrable functions, First and second fundamental theorems of integral calculus, and the integration by parts.

Unit -2 : Improper Integrals and Fourier Series (16 hours)

Improper Integrals: Definition of improper integral of first kind, Comparison test,μ – test for Convergence, Absolute and conditional convergence, Integral test for convergence of series, Definition of improper integral of second kind and some tests for their convergence, Cauchy principle value.
Fourier Series: Definition of Fourier series and examples on the expansion of functions in Fourier series, Fourier series corresponding to even and odd functions, half range Fourier series, half range sine and cosine series

Recommended Books:

1. **Kenneth.A.Ross**, Elementary Analysis: The Theory of Calculus, Second Edition,Undergraduate Texts in Mathematics, Springer , 2013.
   (Chapter 6, Art. 32.1 to 32.11, 33.1 to 33.6 and 34.1 to 34.4)
2. **D Somasundaram and B Choudhary**, First Course in Mathematical Analysis, Narosa Publishing House New Delhi, Eighth Reprint 2013 (Chapter 8, Art. 8.5 and Chapter 10, Art. 10.1)

Reference Books:

1. **R.R.Goldberg**, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. **R.G.Bartle and D.R.Sherbert**, Introduction to Real Analysis, Wiley India Pvt. Ltd., Fourth Edition 2016.
3. **Shanti Narayan and Dr.M.D.Raisinghania,** Elements of Real Analysis, S.Chand& Company Ltd. New Delhi, Fifteenth Revised Edition 2014
4. **Shanti Narayan and P.K.Mittal,** A Course of Mathematical Analysis, S.Chand& Company Ltd. New Delhi, Reprint 2016.
5. **Kishan Hari**, Real Analysis, PragatiPrakashan, Meerut, Fourth Edition 2012.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – E10 **Title of Course: Abstract Algebra**
Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course Objectives: After successful completion of this course the students will able to

1. Basic concepts of group and rings with examples
2. Identify whether the given set with the compositions form Ring, Integral domain or field.
3. Understand the difference between the concepts Group and Ring.
4. Apply fundamental theorem, Isomorphism theorems of groups to prove these theorems for Ring.
5. Understand the concepts of polynomial rings, unique factorization domain.

Unit -1:Groups and Rings **16 hours**

Groups: Definition and examples of groups, group S_3 and Dihedral group D_4,Commutator subgroups and its properties, Conjugacy in group and class equation.
Rings: Definition and example of Rings, Ring with unity. Zero divisor, Integral Domain, Division Ring, Field, Boolean ring, Subring, Characteristic of a ring: Nilpotent and Idempotent elements. Ideals, Sum of two ideals, Examples. Simple Ring**.**

Unit-2: Homomorphism and Imbedding of Ring , Polynomial Ring and Unique Factorization Domain. **16 hours**

Quotient Rings, Homomorphism, Kernel of Homomorphism ,Isomorphism theorems,imbedding of Ring. Maximal Ideals. Polynomial Rings, degree of Polynomial, addition and multiplication of Polynomials and their properties, UFD, Gauss' Lemma.

Recommended Books:

1) Vijay K. Khanna, S.K. Bhambri, A Course In Abstract Algebra, Vikas publishing House Pvt.Ltd., New –Delhi-110014, Fifth Edition 2016.
(Chap. 3 Art. The Dihedral Group, commutator, Chap. 4 Art. Conjugate elements, Chap.7 Art. Subrings, characteristic of a ring, Ideals, Sum of Ideals, Chap. 8 Art. Quotient rings, Homomorphisms, Embedding of Rings, More on Ideals, Maximal Ideals, Chap 9 Polynomial Rings, Unique Factorization Domain.)

Reference Books:

1.Jonh B. Fraleigh, A First Course in Abstract Algebra Pearson Education, Seventh Edition(2014).
2. Herstein I. N, Topics in Algebra, Vikas publishing House,1979.
3.Malik D. S. Moderson J. N. and Sen M. K., Fundamentals of Abstract Algebra, McGrew Hill,1997.
4.Surjeet Sing and QuaziZameeruddin, Modern Algebra, Vikas Publishing House,1991.
5.N.Jacobson, Basic Algebra Vol. I&II, Freeman and Company, New York 1980.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – E11 **Title of Course: Optimization Techniques**

Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course Objectives: The aim of this course is to

1. provide studentbasic knowledge of a range of operation research models and techniques, which can be applied to a variety of industrial and real life applications.
2. Formulate and apply suitable methods to solve problems.
3. Identify and select procedures for various sequencing, assignment, transportation problems.
4. Identify and select suitable methods for various games .
5. To apply linear programming and find algebraic solution to games.

Unit-1 Network optimization models : [16 hours]

Introduction ,Formulation of Linear Programming Problems., Graphical methods for Linear Programming problems. General formulation of Linear Programming problems, Slack and surplus variables,Canonical form, Standard form of Linear Programmingproblems. Transportation problem:Introduction, Mathematical formulation ,Matrix form of Transportation problem.Feasible solution, Basic feasible solution and optimal solution, Balanced and unbalanced transportation problems. Methods of Initial basic feasible solutions: North west corner rule [Stepping stone method], Lowest cost entry method [Matrix minima method], Vogel's Approximation method [Unit Cost Penalty method] ,The optimality test.[MODI method], Assignment Models :Introduction ,Mathematical formulation of assignment problem, Hungarian method for assignment problem. Unbalanced assignment problem.Travelling salesman problem.

Unit-2Quantitative techniques: [16 hours]

Game theory: Basic definitions , Minimax [Maximin] Criterion and optimal strategy, Saddle point , optimal strategy and value of game. Solution of games with saddle point. Fundamental theorem of game theory [Minimax theorem] , Two by two (2 X 2) games without saddle point.Algebraic method of Two by two (2 X 2) games.Arithmetic method of Two by two (2 X 2) games.Graphical method for 2 x n games and m x 2 games.Principle of dominance, Job sequencing : Introduction. Terminology and notations.Principal assumptions.Solution of sequencing problems.Processing n jobs through 2 machines.Processing n jobs through 3 machines.Processing 2 jobs through m machines.Processing n jobs through m machines.

Recommended Book:

1. Sharma S.D., Operations Research - Theory Methods and Applications"Kedarnath, Ramnath Meerut, Delhi Reprint 2015.

Reference Books:

1. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age,2009.
2. Mittal, K. V. and Mohan, C., Optimization Methods in Operations, Research and Systems Analysis, New Age, 2003.
3. Taha, H.A. :Operations Research – An Introduction, Prentice Hall, (7th Edition), 2002.
4. Ravindran, A. , Phillips, D. T and Solberg, J. J., Operations Research: Principles and Practice, John Willey and Sons, 2nd Edition, 2009.
5.J.K.Sharma : Operation Research: Theory and Applications, Laxmi Publications, 2017.
6.KantiSwarup,P.K.Gupta and Manmohan,Operation Research, S.Chand& Co.
7. G.Hadley: Linear programming , Oxford and IBH Publishing Co.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – E12 **Title of Course: Integral Transforms**
Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course Objective : Students be able to

1. understandconcept of Laplace Transform.
2. apply properties of Laplace Transform to solve differential equations.
3. understand relation between Laplace and Fourier Transform.
4. understand infinite and finite Fourier Transform.
5. apply Fourier transform to solve real life problems.

Unit: 1 Laplace and Inverse Laplace Transform. 16 Hours

Laplace Transform **:** Definitions; Piecewise continuity, Function of exponential order, Function of class A ,Existence theorem of Laplace transform. Laplace transform of standard functions.First shifting theorem and Second shifting theoremand examples,Change of scale propertyand examples, Laplace transform of derivativesand examples, Laplace transform of integralsand examples.Multiplication by power of tand examples.Division by tand examples.Laplace transform of periodic functions and examples.Laplace transform of Heaviside's unit step function. Inverse Laplace Transform: Definition Standard results of inverse Laplace transform, Examples , First shifting theorem and Second shifting theoremand examples.Change of scale propertyand Inverse Laplace of derivatives, examples.The Convolution theorem and Multiplication by S, examples.Division by S,inverse Laplace by partial fractions ,examples, Solving linear differential equations with constant coefficients by Laplace transform.

Unit 2 Fourier Transform 16Hours

The infinite Fourier transform and inverse:1Definition examples Infinite Fourier sine and cosine transform and examples.Definition: Infinite inverse Fourier sine and cosine transform and examples.Relationship between Fourier transform and Laplace transform.Change of Scale Propertyand examples.Modulation theorem.The Derivative theorem.Extension theorem.

Convolution theoremand examples.Finite Fourier Transform and Inverse, Fourier Integrals :

Finite Fourier sine and cosine transform with examples.Finite inverse Fourier sine and cosine transform with examples.Fourier integral theorem.Fourier sine and cosine integral (without proof) and examples.

Recommended Book:

1. J.K.Goyal, K.P.Gupta, Laplace and Fourier Transforms, A Pragati Edition (2016).

Reference Books:

1. Dr.S.Shrenadh, Integral Transform, S.ChandPrakashan.
2. B.Davies, Integral Transforms and Their Applications, Springer Science Business Media LLC(2002)
3. Murray R. Spiegel, Laplace Transforms,Schaum's outlines.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – F9 **Title of Course:Metric Spaces**
Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course objectives :Upon successful completion of this course, the student will be able to:
1. acquire the knowledge of notion of metric space, open sets and closed sets.
2. demonstrate the properties of continuous functions on metric spaces,
3. apply the notion of metric space to continuous functions on metric spaces.
4.understand the basic concepts of connectedness, completeness and compactness of metric spaces,
5. appreciate a process of abstraction of limits and continuity to metric spaces,

Unit –1 Limits and Continuous Functions on Metric Spaces 16 hours

Limit of a function on the real line, Metric Spaces, Limitsin Metric Spaces, Functions continuous at a point on the real line, Reformulation, Functions continuous on a metric space, Open Sets, Closed Sets, More about open sets.

Unit 2: Connectedness, Completeness and Compactness 16 hours

Connected Sets, Bounded sets and totally bounded sets,Complete metric spaces, Compact metric spaces, Continuous functions on compact metric spaces.

Recommended Book:

1. R. R. Goldberg, Methods of Real Analysis,Oxford and IBH Publishing House.(2017).

Reference Books:

1. T. M. Apostol, Mathematical Analysis,Narosa Publishing House.(2002)
2. Satish Shirali, H. L. Vasudeva, Mathematical Analysis,Narosa Publishing House.(2013)
3. D. Somasundaram, B. Choudhary, First Course in Mathematical Analysis, Narosa Publishing House,(2018).
4. W. Rudin, Principles of Mathematical Analysis,McGraw Hill BookCompany(1976).
5. Shantinarayan, Mittal, A Course of Mathematical Analysis,S.Chand and Company(2013).
6. J.N. Sharma, Mathematical Analysis-I, Krishna PrakashanMandir, Meerut.(2014)
7. S.C. Malik, Savita Arora,Mathematical Analysis,New age International Ltd(2005).

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – F10
Title of Course: Linear Algebra
Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)
Course Objectives: Upon successful completion of this course, the student will be able to:

1. understandnotion of vector space, subspace, basis.
2. understand concept of linear transformation and its application to real life situation.
3. work out algebra of linear transformations.
4. appreciate connection between linear transformation and matrices.
5. work out eigen values, eigen vectors and its connection with real life situation.

Unit 1: Vector Spaces and Linear Transformations (16 hours)

Vector space: Subspace**,** Sum of subspaces, direct sum, Quotient space, Homomorphism or Linear transformation, Kernel and Range of homomorphism, Fundamental Theorem of homomorphism, Isomorphism theorems, Linear Span, Finite dimensional vector space, Linear dependence and independence, basis, dimension of vector space and subspaces.

Linear Transformation: Rank and nullity of a linear transformation, Sylvester's Law, Algebra of Linear Transformations , Sum and scalar multiple of Linear Transformations. The vector space of Homomorphisms, Product (composition) of Linear Transformations, Linear operator, Linear functional, Invertible and non-singular Linear Transformation, Matrix of Linear Transformations and its examples.

Unit 2: Inner Product Spaces, Eigen values and Eigen vectors (16 hours)

Inner product spaces: Norm of a vector, Cauchy- Schwarz inequality, Orthogonality, Generalized Pythagoras Theorem, orthonormal set, Gram-Schmidt orthogonalization process, Bessel's inequality, Eigen values and Eigen vectors: Eigen space, Characteristic Polynomial of a matrix and remarks on it, similar matrices, Characteristic Polynomial of a Linear operator, Examples and real life (Predatory – Prey problem), examples on eigen values and eigen vectors.

Recommended Book:

1. Khanna V. K. and Bhambri S. K., **ACourseinAbstractAlgebra,**Vikas Publishing House PVT Ltd., New Delhi , 2016, 5th edition,

Reference Books:

1. H. Anton & C. Rorres, **Elementary Linear Algebra** (with Supplemental Applications), Wiley India Pvt. Ltd (Wiley Student Edition), New Delhi , 2016, 11th Edition.
2. S. Friedberg, A. Insel and L. Spence, **Linear Algebra**, Prentice Hall of India, 2014, 4th Edition.
3. Holfman K. and Kunze R., **Linear Algebra,** Prentice Hall of India, 1978.
4. Lipschutz S., **LinearAlgebra,**Schaum's Outline Series, McGraw Hill, Singapore, 1981.
5. David Lay, Steven Lay, Judi McDonald, **LinearAlgebra and its Applications,** Pearson Education Asia, IndianReprint, 2016, 5th Edition.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – F11 **Title of Course: Complex Analysis**
Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course objectives: Upon successful completion of this course, Students will

1. learn basic concepts of functions of complex variable.
2. be introduced to concept of analytic functions.
3. learn concept of complex integration and basic results thereof.
4. be introduced to concept of sequence and series of complex variable.
5. learn to apply concept of residues to evaluate certain real integrals.

Unit 1 :Analytic functions and Complex Integration 16 hours

Basic algebraic and geometric properties of complex numbers, Function of complex variable, Limits, continuity and differentiation, Cauchy Riemann equations, Analytic functions and examples of analytic functions, Exponential function, Logarithmic function, Trigonometric function, Definite integrals of functions, Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat theorem and examples, Cauchy integral formula and examples, Liouville's theorem and the fundamental theorem of algebra.

Unit 2 : Sequences, Series and Residue Calculus 16 hours

Convergence of sequences and series of complex variables, Taylor series and its examples, Laurent series and its examples, absolute and uniform convergence of power series, Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, The three types of isolated singularities, Residues at poles and examples, Zeros of analytic functions, Zeros and poles, Application of residue theorem to evaluate real integrals.

Recommended book:

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw – Hill Education (India) Edition, 2014. Eleventh reprint 2018.

Reference books:

1. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, Second Edition , 2005, Ninth reprint 2013.
2. Lars V Ahlfors, Complex Analysis, McGraw-Hill Education; 3 edition (January 1, 1979).
3. S.B.Joshi, T.Bulboaca and P.Goswamy, Complex Analysis, Theory and Applications, DeGruyter, Germany(2019).

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: DSE – F12 **Title of Course: Discrete Mathematics**

Theory: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course Objectives: Upon successful completion of this course, Students will be able to

1. use classical notions of logic: implications, equivalence, negation, proof by contradiction, proof by induction, and quantifiers.
2. apply notions in logic in other branches of Mathematics.
3. knowelementary algorithms : searching algorithms, sorting, greedy algorithms, and their complexity.
4. apply concepts of graph and trees to tackle real situations.
5. appreciate applications of shortest path algorithms in computer science.

Unit 1 : Mathematical Logic **[16 hours]**

The logic of compound statements: Statements, compound statements, truth values, logical equivalence, tautologies and contradictions, Conditional statements: Logical equivalences involving implication, negation.The contrapositive of a conditional statements, converse, inverse of a conditional statements, biconditional statements.Valid and invalid arguments: Modus Ponens and modus Tollens, Additional valid argument forms, rules of inferences, contradictions and valid arguments, Number system: Addition and subtraction of Binary, decimal, quintal, octal, hexadecimal number systems and their conversions.

Unit 2:Graphs and trees **[16 hours]**

Graphs :Definitions, basic properties,examples, special graphs, directed and undirected graphs, concept of degree, Trails, Paths and Circuits: connectedness, Euler circuits, Hamiltoniancircuits,
Matrixrepresentation of graphs,Isomorphism of graphs,isomorphicinvariants,graph isomorphism for simple graphs.

Trees: Definitions and examples of trees, rooted trees, binary trees and their properties. spanning trees , minimal spanning trees, Kruskal'salgorithm , Prim's algorithm, Dijkstra's shortest path algorithm.

Recommended Book:

1. Susanna S. Epp, Discrete Mathematics with Applications,PWS Publishing Company, 1995. (Brooks/Cole, Cengage learning, 2011)

ReferencesBooks :

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw Hill, 2002.
2. J.P.Tremblay and R. Manohar, Discrete Mathematical Structure with Applications, McGraw– Hill.
3. V. Krishnamurthy, Combinatories:Theory and Applications", East-West Press.
4. Kolman, Busby Ross, Discrete Mathematical Structures, Prentice Hall International.
5. R M Somasundaram, Discrete Mathematical Structures, (PHI) EEE Edition 7.
6. A.B.P.Rao and R.V.Inamdar, A Graduate Text in Computer Mathematics,SUMS [1991]
7. Seymour Lipschutz and Marc Lipson,Discrete Mathematics, Schaum's Outlines Series, Tata McGraw - Hill.
8. Mathematical Foundations of Computer Science: professional publications, JNTU Hyderabad.
11. Liu C. L, Elements of Discrete Mathematics, McGraw – Hill.

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B.Sc. (Mathematics) (Part-III) (Semester–V & VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: CCPM IV **Title of Course: Operation Research**

Sr.No.	Title of the experiment	Sessions
1	Graphical method for linear programming problems	1
2	Transportation Problems[North west corner rule]	1
3	Transportation Problems[Lowest Cost Entry Method]	1
4	Transportation Problems[Vogel Approximation Method]	1
5	Transportation Problems[Test for Optimality MODI method]	1
6	Assignment Problems [Hungarian Method]	1
7	Assignment Problems [Maximization Case]	1
8	Assignment Problems[Travelling Salesman Problem]	1
9	Assignment Problems[Unbalanced Problem]	1
10	Two by two (2 X 2) games without saddle point.	1
11	Algebraic method of Two by two (2 X 2) games.	1
12	Arithmetic method of Two by two (2 X 2) games.	1
13	Graphical method for 2 x n games and m x 2 games.	1
14	Processing n jobs through 2 machines.	1
15	Processing n jobs through 3 machines.	1
16.	Processing 2 jobs through m machines. Processing n jobs through m machines.	1
	Total	**16**

B.Sc. (Mathematics) (Part-III) (Semester–V & VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: CCPM V **Title of Course: Laplace and Fourier Transform**

Sr.No.	Title of the experiment	Sessions
1	Laplace transform of elementary functions	1
2	Evaluation of integrals using properties of Laplace transform	1
3	Effect of multiplication	1
4	Effect of division	1
5	Laplace transform of integrals	1
6	Laplace transform of periodic functions	1
7	Inverse Laplace by using standard results	1
8	Inverse Laplace by Convolution theorem	1
9	Inverse Laplace by partial fractions	2
10	Infinite Fourier sine transform and inverse	1
11	Infinite Fourier cosine transform and inverse	1
12	Change of scale property of Fourier transform	1
13	Convolution theorem of Fourier transform	1
14	Finite Fourier sine transform and inverse	1
15	Finite Fourier cosine transform and inverse	1
	Total	16

B.Sc. (Mathematics) (Part-III) (Semester–V & VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: CCPM VI **Title of Course: Mathematical Computation Using Python**

1.

Sr. No.	Topic	No. Of Practicals
1	**Introduction to Python:** Python, Anaconda, Spyder IDE, Python Identifiers and Keywords , data types, simple mathematical operation, Indentation and Comments., Input and Output, First Python program.	**1**
2	**Expression and operators:** Expression, Boolean expression, logical operations: comparison operator, membership operator, identity operator, bitwise operator. Order of evaluation. File Handling : open, read, write, append modes of file.	**1**
3	**Conditional Statements:** if-else, nested if-else, if-elif-else, try-except block.	**1**
4	**Looping Statements, Control statements:** Looping Statements: for loop, while loop , Nested loops Control Statements: break, continue and pass.	**1**
5	**Functions:** Built-in functions, User-defined functions, Arguments, recursive function, Python Anonymous/Lambda Function, Global, Local and Nonlocal variables and return statement.	**1**
6	**Modules and packages in Python :** Modules, import, import with renaming, from-import statement, math module ,cmath module , random module, packages.	**1**
7	**Python Data structure:** Strings, list, tulpes, dictionary, set and array.	**1**
8	**Operations on set and array:** Set operations, Intersection, union, difference, symmetric difference, searching and sorting.	**1**
9	**Systems of linear algebraic equations:** Gauss Elimination Method, LU Decomposition Methods	**1**
10	**Roots of Equations:** Bisection, Newton-Raphson Method	**1**
11	**Initial Value Problems:** Euler's Method, Runge-Kutta Methods.	**1**
12	Magic square and Area calculation without measurement.	**1**
13	**Graph Theory : Networkx** Grpah, nodes, edges, directed graph, multigraph, drawing graph, Google page rank by random walk method	**1**
14	**Collatz conjecture and Monte Hall problem**	**1**
15	**Data compression using Numpy**	**1**
16	**Data visualization in Python:** 2D and 3D plot in python : line plot, bar plot, histogram plot, scatter plot, pie plot, area plot, Mandelbrot fractal set visualization.	**1**
	Total	**16**

Recommended Book:

1.JaanKiusalaas, ***Numerical Methods in Engineering with Python3***, Cambridge University Press.
2. Amit Saha, ***Doing Math with Python***, No Starch Press, 2015.
3. YashwantKanetkar and Aditya Kanetkar,***Let Us Python***, BPB Publication, 2019.

B.Sc. (Mathematics) (Part-III) (Semester–V & VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course Code: CCPM VII **Title of Course: Project, Study- Tour, Viva – Voce**

A :PROJECT [30 Marks]

Each student of B.Sc. III is expected to read, collect, understand the culture ofMathematics, its historic development. He is expected to get acquainted withMathematical concepts, innovations, relevance of Mathematics. Report of the projectwork should be submitted through the respective Department of Mathematics.Evaluation of the project report will be done by the external examiners at the time ofannual examination.

B. STUDY TOUR [05 Marks] :

It is expected that the tour should contain at least renown academic institution so that the visiting students will be inspired to go for higher studies in Mathematics.

C. SEMINARS: [05 Marks]

Students should present a seminar before the B.Sc.III class on some topic in Mathematics.

D. VIVA-VOCE (on the project report). [10 Marks]

Nature of Question papers (Theory)

Common nature of question for theory paper mentioned separately:
There will be practical at the end of second term that is annual pattern,

Nature of Practical Question Paper

(1) Core Course Mathematics Practicals - IV
This carries 50 marks.
Examination : 40 Marks
Journal : 10 Marks

(2) Core Course Mathematics Practicals - V
This carries 50 marks.
Examination : 40 Marks
Journal : 10 Marks

(3) Core Course Mathematics Practicals - VI
This carries 50 marks.
Examination : 40 Marks
Journal : 10 Marks

(4) Core Course Mathematics Practicals - VII
This carries 50 marks.
Project : 30 Marks (External Examiner)
Study Tour : 05 Marks (External Examiner)
Seminar : 05 Marks (External Examiner)
Viva Voce : 10 Marks (External Examiner)

Note : Each student of a class will select separate topic for project work. He/ Sheshould submit the reports of his / her project work , Study tour reportto the department and get the same certified.

Teaching Periods :

(i) Total teaching periods for Paper –DSE E-9. E-10,E-11,E-12, F-9,F-10, F-11,F-12 are 12 (Twelve) per week.3 (Three) periods per paper per week.
(ii) Total teaching periods for CCPM-IV, V,VI,VII for the whole class are 20 (Twenty) per week. 5 (Five) periods per Lab. Perweek.