# SYLLABUS FOR

# THE FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)

## B.Sc. Fifth and Sixth Semester

## As per provision of NEP-2020

## Implemented fromAcademic Year 2022 onwards


## Session 2025-26

***DEPARTMENT OF MATHEMATICS***

**GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE,**

**RAJNANDGAON (C.G.)**

# B. SC. (Multiple Major) – DEGREE COURSE (Session 2025-26)
## Major - Mathematics

| | SEMESTER | COURSETYPE | Theory/ Practical | COURSE CODE | PAPER TITLE | CREDIT L | T | P | Max marks | ESE | IA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| THIRD YEAR | V | DSC-VA | Theory | | Ring Theory and Linear Algebra | 3 | 1 | 0 | 100 | 80 | 20 |
| | | DSE-IIIA | Theory | | Mechanics | 3 | 1 | 0 | 100 | 80 | 20 |
| | | DSE –IVA | Theory | | Riemann Integration and Series of Functions | 3 | 1 | 0 | 100 | 80 | 20 |
| | | SEC-VA | Practical | | Programming with Python | 0 | 0 | 2 | 50 | 40 | 10 |
| | VI | DSC-VIA | Theory | | Metric Space and Complex Analysis | 3 | 1 | 0 | 100 | 80 | 20 |
| | | DSE-VA | Theory | | Number Theory | 3 | 1 | 0 | 100 | 80 | 20 |
| | | DSE- VIA | Theory | | Graph Theory | 3 | 1 | 0 | 100 | 80 | 20 |
| | | Internship | | | Internship | 0 | 0 | 2 | 50 | 40 | 10 |

**ESE- End Semester Exam, IA-Internal Assessment**

**Instruction for Question paper setting**

**End Semester Exam (ESE) for DSC, DSE and GE**

**There will be 03 sections of question of 80marks**

**Section A-** section A will be very short answer type questions consisting 8 questions of 2 marks, two question from each unit.

**Section B-** section B will be short answer type questions consisting 4 questions of 6 marks each, one question from each unit with internal choice.

**Section C-** section B will be long answer (Descriptive) type questions consisting 4 questions of 10 marks each, one question from each unit with internal choice.

**End Semester Exam (ESE) for SEC-**There will be 8 questions of 8 marks each, out of which any 5 question to be answer. Total marks will be 40.

**Minimum Pass Marks 40%**

| Section | Maximum Marks (80) | | Maximum Marks (40) | |
|---|---|---|---|---|
| A | 2 x 8 = 16 | Very short answer type questions consisting 8 Questions of 2 marks, two question from each unit. | 8 x 5 = 40 | 8 questions of 5 mark each, out of which any 5 question to be answer. |
| B | 6 x 4 = 24 | Short answer type questions consisting 4 questions of 6 marks each, one question from each unit with internal choice. | | |
| C | 10 x 4 = 40 | long answer (Descriptive) type questions consisting 4 questions of 10 marks each, one question from each unit with internal choice | | |

## SYLLABUS OF 4 YEARS UG PROGRAM (FYUGP) IN MATHEMATICS, GOVT. DIGVIJAY AUTONOMOUS P G COLLEGE, RAJNANDGAON, AS PER NEP 2020 (SEMESTER-V AND VI)

### Program Objective

PO1- It is to give foundation knowledge for the students to understand basic mathematics including applied aspect for the same.

PO2- It is to develop enhanced quantative skills and pursuing higher mathematics and research as well as.

PO3- Students will be able to develop solution –oriented approach towards various issues related to their environment.

PO4– Students will become employable in various governments, public and private sectors.

PO5- Scientific tempers in general and mathematical temper in particular will the developed in students.

PO6- Sufficient subject matter competence and enable students to prepare for various competitive examinations such as IIT-JAM, GATE, GRE, UGC-CSIR, NET/JRF and Civil Services Examinations

### Program Specific Outcome (PSO)

PSO1- Student should be able to process recall basic idea about mathematics which can be displayed by them.

PSO2- Student should have adequate exposure to many aspects of mathematical sciences.

PSO3- Student is equipped with mathematical modeling ability, critical mathematical thinking and problem solving skill etc.

PSO4- Student should be able to apply their skills and knowledge in various fields of studies including science, engineering, commerce and management.

# B.Sc. III Year
# (MATHEMATICS)
## Detailed Syllabus For
# DEGREE IN MATHEMATICS

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major 1- Mathematics**

| | |
|---|---|
| Session: **2025-26** | Program: **B.Sc.** |
| Semester: **V** | Subject: **Mathematics** |
| Course Type: **DSC-VA** | Course Code: |
| Course Title: | **RING THEORY AND LINEAR ALGEBRA** |
| Credit: **4** | Lecture: **60** |
| M.M. 100 = **(ESE 80+IA 20)** | Minimum Passing Marks: **40%** |

| **Title** | **RING THEORY AND LINEAR ALGEBRA** |
|---|---|
| **Course LearningOutcome:** | (i) Linear algebra is a basic course in almost all branches of science. The objective of this course is to introduce a student to the basics of linear algebra and some of its applications.<br>(ii) Students will be able to know the concepts of polynomial ring vector space, and other related properties which will prepare the students to take up further applications in the relevant fields.<br>(iii) Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix.<br>(iv) Compute inner products and determine orthogonality on vector spaces, including Gram–Schmidt orthogonalization to obtain orthogonal basis.<br>(v) The student will use this knowledge in computer science, finance mathematics, industrial mathematics and bio mathematics. After completion of this course students appreciate its interdisciplinary nature. |

| Units | Lectures | Lectures (15 x 4 = 60) | Credit |
|---|---|---|---|
| | | **RING THEORY AND LINEAR ALGEBRA** | |
| I | 15 | **Polynomial Ring**<br>Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in Z [x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains. | 1 |
| II | 15 | **Vector spaces**<br>Definition and properties of Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. | 1 |
| III | 15 | **Linear Transformations**<br>Definition and examples, Algebra of linear transformations, Matrix of a linear transformation, Change of coordinates, Rank and nullity of a linear transformation and rank-nullity theorem .Dual and second dual of a vector space, Transpose of | 1 |

| | | | |
|---|---|---|---|
| | | Matrices, diagonalization of matrix. Cayley-Hamilton theorem, Minimal polynomial. | |
| IV | 10 | **Inner Product Spaces**<br>Inner product spaces and orthogonality, Cauchy-Schwarz inequality, Gram-Schmidt orthogonalisation, Diagonalisation of symmetric matrices. Bilinear, Quadratic and Hermitian Forms. | 1 |

| | |
|---|---|
| **List of Books** | 1. John B. Fraleigh, *A First Course in Abstract Algebra,* 7th Ed., Pearson, 2002.<br>2. Gallian, J. A., *Contemporary Abstract Algebra,* 4th Ed., Narosa Publishing house, 1999<br>3. M. Artin, *Abstract Algebra,* 2nd Ed., Pearson, 2011.<br>4. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.¬ 21<br>5. Kenneth Hoffman and Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.¬<br>6. S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.<br>7. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.¬<br>8. Linear Algebra by J.N. Sharma and A.R. Vasista, published by Krishna Prakashan Mandir, Meerut- 250002<br>9. Rings and linear Algebra by Pundir and Pundir, Pragati Prakashan , Merath<br>10. A Textbook of B.Sc. Mathematics Linear Algebra, S Chand publications<br>11. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS |

# GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major - Mathematics**

| | |
|---|---|
| Session: 2025-26 | Program: B.Sc. |
| Semester: V | Subject: Mathematics |
| Course Type: DSE-IIIA(Theory) | Course Code: |
| Course Title: | MECHANICS |
| Credit: 4 | Lecture: 60 |
| M.M. 100 = (ESE 80+IA 20) | Minimum Passing Marks: 40% |

| Title | MECHANICS |
|---|---|
| Course Learning Outcome: | 1. Familiarize with subject matter, which has been the single centre, to which were drawn mathematicians, physicists, astronomers, and engineers together.<br>2. Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body.<br>3. Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight.<br>4. Deal with the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particles. |

| Units | Lectures | Lectures (15 x 4 = 60) | Credits |
|---|---|---|---|
| I | 15 | **Analytical Conditions of Equilibrium of Coplanar Force** Equilibrium under three forces, Lami's theorem, **Projectile** : Definitions, To Find the time of flight, time to reach the highest point, Range on horizontal plane , projection on inclined plane. | 1 |
| II | 15 | **Virtual work** : Principle of Virtual work for coplanar forces acting at different points of a rigid body, to find Tension on a string or Thrust on rod, Virtual work for bodies resting an inclined planes | 1 |
| III | 15 | **Catenary:** Definitions To find the intrinsic equation, Cartesian equation of Catenary, Geometrical properties of the Catenary, Sag of telegraph wires (tightly stretched wires) | 1 |
| IV | 15 | **Simple Harmonic Motion (SHM):** Simple Harmonic Motion, Velocities & Acceleration along Radial Transverse Directions, Angular velocity and Angular Acceleration, Radial and Transverse component of Velocity and Acceleration | 1 |

| List of Books | |
|---|---|
| | 1. S. L. Loney (2006). An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies. Read Books.<br>2. P. L. Srivatava (1964). Elementary Dynamics. Ram Narin Lal, Beni Prasad Publishers Allahabad.<br>3. J. L. Synge & B. A. Griffith (1949). Principles of Mechanics. McGraw-Hill.<br>4. S. Ramsey (2009). Statics. Cambridge University Press.<br>5. S. Ramsey (2009). Dynamics. Cambridge University Press.<br>6. R. S. Varma (1962). A Text Book of Statics. Pothishala Pvt. Ltd.<br>7. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS |

# GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major – Mathematics**

**(For students of Science stream who have not chosen Mathematics as one of the DSC Course)**

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|---|---|
| Session: **2025-26** | Program: **B.Sc.** |
| Semester: **V** | Subject: **Mathematics** |
| Course Type: **DSE-IVA(Theory)** | Course Code: |
| Course Title: | **RIEMANN INTEGRATION AND SERIES OF FUNCTIONS** |
| Credit: **4** | Lecture: **60** |
| M.M. 100 = **(ESE 80+IA 20)** | Minimum Passing Marks: **40%** |

| **Title** | **RIEMANN INTEGRATION AND SERIES OF FUNCTIONS** |
|---|---|
| **Course Learning Outcome:** | **The course will enable the students to:**<br>1. Learn about some of the classes and properties of Riemann integrable functions,<br>2. Learn about the applications of the Fundamental theorems of integration.<br>3. Know about improper integrals including, beta and gamma functions.<br>4. Learn about Cauchy criterion for uniform convergence and Weierstrass M-test for uniform convergence.<br>5. Know about the constraints for the inter-changeability of differentiability and integrability with infinite sum. |

| **Units** | **Lectures** | **Lectures (15 x 4 = 60)** | **Credits** |
|---|---|---|---|
| I | 15 | **Riemann Integration:** Definition of Riemann integration, Inequalities for upper and lower Darboux sums, Inequality of integrals, Refinement of partitions, Darboux's theorem, Necessary and sufficient conditions for the Riemann integrability, Integrability of the sum, difference, product, quotient and modulus of integrable functions, Definition of Riemann integration by Riemann sum and equivalence of the two definitions, Riemann integrability of monotone functions and continuous functions | |
| II | 15 | Definitions of piecewise continuous and piecewise monotone functions and their Riemann integrability, The fundamental theorem of Calculus, First mean Value theorem, Generalized First mean Value theorem, Second Mean Value Theorem, and the integration by parts. | 1 |
| III | 15 | **Improper Integral:** Improper integral, Integration of unbounded functions with finite limit of integration, Comparison test for convergence at a of $\int_a^b f dx$ : Comparison Test I (Comparison of integrals), Comparison Test II (limit form), General Test of Convergence, Absolute convergence, Infinite range of integration, Comparison test for convergence at $\infty$ , Integrand as product of functions, | 1 |
| IV | 15 | Pointwise convergence, uniform convergence on an interval, Cauchy's criterion for uniform convergence, Test for uniform convergence of sequences, Test for uniform convergence of series, Properties of uniformly convergent sequence and series, Uniform convergence and continuity, Dini's theorem on uniform convergence, Uniform convergence and integration, Uniform convergence and differentiation, Weierstrass Approximation theorem, | 1 |

**List of Books**


1. K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
2. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.
4. S.C. Malik and Savita Arora , Mathematical Analysis (Fourth Edition) by S.C. Malik and Savita

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major – Mathematics**

**Department- Mathematics**

| | |
|---|---|
| Session: **2025-26** | Program: B.Sc. |
| Semester: **V** | Subject: **Mathematics** |
| Course Type: **SEC-VA(Practical)** | Course Code: |
| Course Title: | **PROGRAMMING WITH PYTHON** |
| Credit: **2** | Practical Hours : **02 Hours/week**<br>**Total practical hours- 28 Hours** |
| M.M. 100 = **(ESE- 40+IA -10)** | Minimum Passing Marks: **40%** |

| Title | PROGRAMMING WITH PYTHON |
|---|---|
| **Course Learning Outcome:** | 1. Learn the syntax and semantics of Python programming language.<br>2. Write Python functions to facilitate code reuse and manipulate strings.<br>3. Understand the use of built-inunctions to navigate the file system<br>4. Apply the concepts of file handling. |

| Units | Lectures | Lectures (15 x 2 = 30) | Credits |
|---|---|---|---|
| I | 15 | **Introduction, Basics and Program flow:** Python character set, Tokens, Variables and assignments, print statement, comments, Python data structure and data types, string operation in Python, Simple input and output including simple output formatting, operators in Python, expressions, standard library modules, Debugging, indentation, Flow of control (if, ifelse, ifelif, nestedif), range function, iteration/looping statements, String and list manipulation, Tuples, dictionaries, sorting techniques. | 1 |
| II | 15 | **Functions, libraries and File handling:** Understanding and creating your own functions, Function parameters, Flow of execution in A function call, passing parameters, returning values from functions, Scope of a function, Importing modules in a Python using standard library functions and Modules, Creating, A Python library, Data files, Operating and closing files, working with text files, Standard input, output and error streams, Working with binary and CSV files. | 1 |

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|---|---|
| List of Practical's | 1Programs to demonstrate the usage of operators and Input / Output statements<br>2 Programs to demonstrate the usage of conditional statements<br>3 Programs to demonstrate usage of control structures<br>4 Programs to demonstrate the usage of Functions<br>5 Programs to demonstrate the usage of recursion functions<br>6 Programs to demonstrate the usage of String functions<br>7 Programs to demonstrate the usage of lists.<br>8 Programs to demonstrate the usage of dictionaries<br>9 Programs to demonstrate the usage of tuples.<br>10 Programs to apply the concepts of file handling and regEx using packages.<br>11 Programs to search and sort the numbers<br>12 Programs to demonstrate the working of scraping websites with CSV |
| List of Books | 1. Automate theBoring Stuff with Python-AlSweigart,WillamPollock,2015<br>2. Python Cook Book-David Beazely and BrainK.Jones2022.<br>3. Basic Python Programming for Beginners –Varada Rajkumar,Marapalli Krishna, Jaya Prakash,BlueRose Publishers,2022.<br>4. Python-John Shovicand Alan Simpson, Paperback,2020.<br>5. Learning Python -MarkLutz,O'ReillyMedia,Paperback,2ndedition,2020.<br>6. Programming and Problem Solving Through Python-SatishJain and Shashi Singh, BPB Publications,2020 |

# GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major – Mathematics**

## Department- Mathematics

| | |
|---|---|
| Session: **2025-26** | Program: B.Sc. |
| Semester: **VI** | Subject: **Mathematics** |
| Course Type: **DSC-VIA (Theory)** | Course Code: |
| Course Title: | **METRIC SPACES AND COMPLEX ANALYSIS** |
| Credit: **4** | Lecture: **60** |
| M.M. 100 = **(ESE 80+IA 20)** | Minimum Passing Marks: **40%** |

| **Title** | **Metric Spaces and Complex Analysis** |
|---|---|
| **Course Learning Outcome:** | **The course will enable the students to:**<br>1. Understand the basic concepts of metric spaces;<br>2. Correlate these concepts to their counter parts in real analysis;<br>3. Appreciate the abstractness of the concepts such as open balls, closed balls, compactness, connectedness etc<br>4. Understand complex variable, Mappings and Continuity, Derivatives.<br>5. Learn about Analytic functions and their applications.<br>6. Solve real-life problems of complex analysis |

| Units | Lectures | Lectures (15 x 4= 60) | Credits |
|---|---|---|---|
| I | 15 | **Metric spaces:** Definition and examples. Open and closed balls, neighborhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, subspaces, dense sets, | 1 |
| II | 15 | **Completeness in Metric Spaces**<br>Sequences in metric spaces, Cauchy sequences, Complete metric space with Examples, Cantor intersection Theorem<br>**Continuity & Uniform Continuity in Metric Spaces**<br>Continuous mappings, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mapping. | 1 |
| III | 15 | **Complex Analysis:** Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae, Cauchy-Riemann equations, Sufficient conditions for differentiability; | 1 |
| IV | 15 | Analytic functions and their examples, Harmonic Function, method of construction of a regular function (Milne-Thomson's Method).<br>Conformal Mapping, necessary. & sufficient Condition; inverse point, bilinear transformation, critical point, cross ratio, fixed point. | 1 |

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|---|---|
| **List of Books** | 1. Metric Spaces and Complex analysis, by K P Gupta and Sudhir Pundhir, Pragati Prakashan 2019.<br>2. Mathematical Analysis by S C Malik and Savita Arora, New Age International(P)Limited, Publishers, Fifth Edition, 2017<br>3. A Course of Mathematical Analysis by Shanti Narain., S. Chand Publishing, 2013.<br>4. Metric Spaces by Satish Shirali and H.L. Vasudeva, Springer, First Indian Print, 2009.<br>5. Topology of Metric Spaces, Second edition, by S. Kumarsen, Narosa Publishing House. New Delhi, 2014.<br>6. Introduction to Topology and Modern Analysis by G.F. Simmons, Tata McGraw Hill. New Delhi, 2004.<br>7. Function of Complex Variable, Second Edition, by Shanti Narain, S Chand & Co Ltd, 2005.<br>8. Complex variable and applications, Ninth Edition by James Brown & Ruel Churchill, McGraw Hill Higher Education, 2013.<br>9. Suggested digital platform: NPTEL/SWAYAM/MOOCS |

# GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major – Mathematics**

**Department- Mathematics**

| | |
|---|---|
| Session: **2025-26** | Program: B.Sc. |
| Semester: **VI** | Subject: **Mathematics** |
| Course Type: **DSE-VA (Theory)** | Course Code: |
| Course Title: | **NUMBER THEORY** |
| Credit: **4** | Lecture: **60** |
| M.M. 100 = **(ESE 80+IA 20)** | Minimum Passing Marks: **40%** |

| **Title** | **NUMBER THEORY** |
|---|---|
| **Course Learning Outcome:** | **This course will enable the students to:**<br>1. Know about distribution of primes and congruence.<br>2. Solve number theoretic functions<br>3. Learn primitive, quadratic reciprocity law and public key encryption |

| Units | Lectures | Lectures (15 x 4= 60) | Credits |
|---|---|---|---|
| I | 15 | **Distribution of Primes and Theory of Congruences:** Linear Diophantine equations, Prime counting functions, Prime Number Theorem, Goldback Conjecture, Fermat and Mersenne Primes, Congruence Relations and its properties, Linear Congruence and Chinese Remainder Theorem, Fermat's Little Theorem, Wilson's Theorem | 15 |
| II | 15 | **Number Theoretic Functions:** Number Theoretic Functions for dum and number of divisors, Multiplicative functions, The Mobious Inversion Formula, The greatest integer function, Euler's phi function and properties, Euler's theorem. | 15 |
| III | 15 | **Primitive:** The order of integer modulo n, Primitive roots for prime, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, and Euler's criterion. | 15 |
| IV | 15 | **Quadratic Reciprocity Law and Public key Encryption:** The Legendre symbol and its properties, Quadratic reciprocity, Quadratic congruences with composite moduli; public key encryption, RSA encryption and decryption. | 15 |

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|---|---|
| **List of Books** | 1.Burton, David M. (2012): Elementary Number Theory (7th ed.) Mc-Graw Hill Education Pvt. Ltd. Indian Reprint. |
| **Reference Book Recommended** | 2. Jones, G. A., & Jones, J. Mary. (2005): elementary Number Theory. Undergraduate Mathematics Series(SUMS). First Indian Print. |

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. SC. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major – Mathematics**

## Department- Mathematics

| | |
|---|---|
| Session: **2025-26** | Program: B.Sc. |
| Semester: **VI** | Subject: **Mathematics** |
| Course Type: **DSE-VIA (Theory)** | Course Code: |
| Course Title: | **GRAPH THEORY** |
| Credit: **4** | Lecture: **60** |
| M.M. 100 = **(ESE 80+IA 20)** | Minimum Passing Marks: **40%** |

| **Title** | **GRAPH THEORY** |
|---|---|
| **Course Learning Outcome:** | **This course will enable the students to:**<br>1. Appreciate definition and basics of graphs along with types and their examples.<br>2. Understand the definition of tree and learn its application to fundamental circuits<br>3. Know the applications of graph theory to network flows.<br>4. Understand the notation of planarity of a graph.<br>5. Relate the graph theory to the real-world problems. |

| **Units** | **Lectures** | **Lectures (15 x 4= 60)** | **Credits** |
|---|---|---|---|
| I | 15 | **Path circuits and graph isomorphism:** Definition and examples of a graph, Subgraph, Walks, Paths and circuits; Connected graphs, disconnected graphs and components of a graph; Euler and Hamiltonian graphs, Graph isomorphisms, Adjacency matrix and incidence matrix of a graph, Directed graphs and their elementary properties. | 15 |
| II | 15 | **Planar Graphs:** Planar graph, Euler theorem for a planar graph, Various representations of a planar graph, Dual of a planar graph, Detection of planarity, Kuratowski's theorem. Weighted graph, Travelling salesman problem, shorted path Dijkstra's algorithm. | 15 |
| III | 15 | **Cut-Sets and Cut-Vertices:**Cut-set of a graph and its properties, Fundamental circuits and cut-sets, Cut-vertices, Connectivity and separability, Network flows, 1-isomorphism and 2- isomorphism. | 15 |
| IV | 15 | **Trees and Fundamental Circuits:** Definition and properties of trees, Rooted and binary trees, Cayley's theorem on a counting tree, Spanning tree, Fundamental circuits, Minimal spanning trees in a connected graph. | 15 |

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|---|---|
| **List of Books** | 1 . R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.<br>2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications. |
| **Reference Book Recommended** | 3. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.<br>4. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition), Pearson.<br>5. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson. |

# GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

**B. Sc. (Multiple Major) - DEGREE COURSE (Session 2025-26)**

**Major – Mathematics**

## Department- Mathematics

| | |
|---|---|
| Session: **2025-26** | Program: B.Sc. |
| Semester: **VI** | Subject: **Mathematics** |
| Course Type: **Internship (Practical)** | Course Code: |
| Course Title: | **Internship (Practical)** |
| Credit: **2** | **Credit internship is equal to 30 hrs on field experience** |
| M.M. 50 = **(10+20+10+10)** | Minimum Passing Marks: **40%** |

| Title | Internship (Practical) |
|---|---|
| **Course LearningOutcome:** | **At the end of the course students will be able to:**<br>1. Conduct the field visit based on the objectives of the internship<br>2. Participate in a professional activity and gain practical work experience.<br>3. Learn the behavioral approach and fascinate in communication.<br>4. Interact with the different personalities of local agencies.<br>5. Prepare the report with sound techniques/ technology |

**Internship**

A course requiring students to participate in a professional activity or work experience or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations for 2 credits. Internships involve working with local industry, local governments (such as panchayats, and municipalities) or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

**Note;**

1. Credit internship is equal to 30 hrs on field experience.
2. Internship shall be Discipline Specific of 45-60 hours (2 credits) with duration 1-2 weeks.
3. Internship will be part-time (weekly 4hrs in the academic session for 12-13 weeks).
4. Internship mentor/supervisor shall avail work allotment during the 6th semester for Maximum of 20 hours
5. The student should submit the final internship report (45-60 hours of Internship) to the mentor for completion of the internship.
6. Method of evaluation: Presentations/Report submission/Activity etc

**Formative Assessment for Internship**

**Assessment Distribution of Marks**

Internal Assessment Test- 10 — Case Study/ Assignment/ Field activity/Project etc - 20

Report Presentation and Discussion -10 — Viva-Voce -10

**Total 50Marks**

**Whenever an internship is not feasible, the students can choose the Project work**

**Project Work**

A project may be undertaken in the form of a case study or otherwise and data be collected, if required, as the case may be. The topic of the project be chosen in consultation with the assigned supervisor and the candidate should prepare a summary/synopsis of the proposed project related to some topic in Mathematics. The project work may include in Educational Institutions /R & D organizations/review of current literature/ theoretical methods/ Mathematical applications. The candidate needs to collect data/related literature on any particular aspect of the identified topic and shall prepare the report of the project from historical point of view, or as a survey or unification of different aspect