**Sant Gadge Baba Amravati University, Amravati**

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**Faculty: Science and Technology**

**Programme: M.Sc. Mathematics**

**POs**
At the end of the programme, students would be able to

- Apply knowledge of Mathematics, in all the fields of learning including higher research and its extensions.
- Innovate, invent and solve complex mathematical problems using critical understanding, analysis and synthesis.
- Adjust themselves completely to the demands of the growing field of Mathematics by lifelong learning.
- Effectively communicate about their field of expertise on their activities, with their peer and society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations
- Crack lectureship and fellowship exams approved by UGC like CSIR – NET and SET.

**PSOs**
Upon completion of the programme successfully, students would be able to

- Develop problem-solving skills and apply them independently to problems in pure and applied mathematics.
- Understand advanced mathematical knowledge and skills that prepare them to pursue further studies and research.
- Understand advanced and pure mathematical concepts and research.
- Create knowledge, capability in formulating and analyzing mathematical models of real life applications.
- Analyze the latest advances in applied mathematics such as numerical computations and mathematical modeling in physical sciences.

**Employability Potential of the Programme :**

After completing M.Sc. in Mathematics, career will be more stable and successful. The private and government sectors both have thousands of job options available. The government sector also wants a good mathematician, who can manage the data and business mode. Every business requires financial activity and data management for better improvement and success. Various companies have a position like numerical operation and accountant. So career after **M.Sc. Mathematics** is very fruitful.
The job profile option after completing the M.Sc. Mathematics as follows:

**1. Assistant Professor in Mathematics.**
Many of the colleges and Universities/Institutes can offer job as a Assistant professor after clearing SLET/ CSIR-NET examination or Ph.D. degree.

**2. Junior Research Fellow.**
Junior research fellow exam is now conducted by NTA. Normally only top candidates acquire the JRF post after clearing the NET/GATE exam.

3. Scientific Officer.

Students can apply for a scientific office job in the industry such as **ISRO** (the Indian Space research Organization), **DRDO** (Defense Research and Development Organization), TIFR ( Tata Institute of Fundamental Research) and **NAL** (National Aeronautics Limited).

4. Operational Research.

Students can also become operational researcher if they are good at mathematics. Under this profession basically, they have to solve the business profitability, improve efficiency, and complex organization problems. Also have to

understand the assigned assignment in deep. And they have to use **mathematical programming, analyst techniques, optimizatio**n, and so on for enhancing the project planning and skills.

5. Statistical Research.

A career in statistical research is very interesting. It presents the company's statistical businesses at a modest and technical level. Under this profession, students will get the chance of analyzing, researching, using mathematical tools, algorithms, and theories, and become a professor.

6. ICT

**Information and communication technology** is playing a big role in this platform. ICT always offer a new role for Mathematics Post Graduate students. Such as the development of ICT, Regular Maintenance, Manufacturing and design part, general part, and so on.

7. Data Science Modelers.

The demand for data science specialists is huge because every company wants to convert its data into the required information. Making good information sheet help company decision-maker to take the best decision for the company.

8. Banking – Investment Banking.

Many famous investment banks provide financial advice to the customer. These professions help to increase the equity and debt market. A career in investment banking is a very high-profile post along with good stability. In this profession, students have to deal with the clients and the market. Some basic skills required for an investment banker. Integrity, knowledge of finance and the markets, interpersonal skills, communication, etc. **Job opportunity** comes from varies area such as finance, wells Fargo, American Express, Deutsche bank, CICNA, Barclay's bank, AIG, JP Morgan, Goldman Sachs, etc.

**Syllabus Prescribed for the year 2022-23 ,PG Programme**

**Programme : M.Sc.-I ( Mathematics)**

**Semester- I**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| DSC-I / Mathematics | Real Analysis | 06 |

**COs:**

**On successful completion of this course, students would be able to**

- restate the ideas and concept of Riemann – Stieltjes integral with some of its properties and apply the fundamental theorem of integration.
- apply the Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence of sequences.
- differentiate between uniqueness theorem for power series, Abel's limit theorem and Tauber's first theorem.
- recognize the functions of several variables, linear transformation, partial and higher order derivatives in an open subset of R.

- demonstrate the inverse function theorem, implicit function theorem and solve problems on maxima and minima of a function.

| Unit | Content |
|---|---|
| Unit I | Definition and existence of Riemann Stieltjes integral, properties of the integral, Integration and differentiation, the fundamental theorem of calculus, integral of vector valued function, rectifiable curves. **(11 Hrs.)** |
| Unit II | Sequences and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel' s and Dirichlet's tests for uniform convergence, uniform convergence and continuity , uniform convergence and integration, uniform and differentiation, Weierstrass approximation theorem. **(10 Hrs.)** |
| Unit III | Rearrangement of terms of a series, Riemann's theorem. Power series, Uniqueness theorem for power series, Abel's limit theorem, Tauber's first theorem. **(11 Hrs.)** |
| Unit IV | Functions of several variables, linear transformation, derivatives in an open subset of Rn, chain Rule, partial derivatives, interchange of order of differentiation, Derivatives of higher order, Taylor's theorem. **(11 Hrs.)** |
| Unit V | Inverse function theorem. Implicit function theorem, Jacobians, Extremum problems with constraints, Lagrange's multiplier method, Examples on Maxima and Minima, Differentiation of integrals. **(11 Hrs.)** |

**Text Book:**

(1)Walter Rudin, Real and Complex Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

**References Books :**

(1) Apostol T .M., Mathematical Analysis, Narosa Publishing House,New Delhi, 1985.
(2) Eurl D.Rainville : Infinite series, The Macmillan Company , New York.
(3) Friedman A., Foundations of Modern Analysis, Holt Rinehart and Winston, Inc, New York, 1970.
(4) Hewitt E. and Starmberg, Real and Abstract Analysis, Berlin, Springer 1969.
(5) Jain P .K. and Gupta V. P., Lebesque Measure and Integration, New Age international (P) Ltd., Published, New Delhi, 1986, (Reprint2000)
(6) Gabriel Klambaucer , Mathematical Analysis Marcel Dekkar , Inc.,New York, 1975.
(7) Natanson I.P ., Theory of Function of real variables, Vol.-I, Frederick Ungar Publishing Co.1961.
(8) Parthasarathy K.R., Introduction to Probability and Measure,Macmillan Company of India, Delhi, 1977.
(9) Royden H.L., Real Analysis, Macmillian Pub. Co. Inc., 4th Edition,New York, 1993.
(10) R.R.Goldber g : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi - 1970.
(11) Serge Lang, Analysis I & II, Addison - Wesley Publishing CompanyInc., 1969.
(12) S.C.Malik and Savita Arora: Mathematical Analysis, Wiley Fastern Ltd., New Delhi.
(13) S.C.Malik and Savita Arora : Mathematical Analysis, New Age International (P.) Ltd.2010, Fourth Edition.
(14) Shani Narayan : A Course of Mathematical Analysis, S.Chand and Company, New Delhi.
(15) White A.J., Real Analysis, an introduction.
(16) Karade T .M. and Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, 2004.
(17) Robert ,G.Bartle,Donald R.Sherbert:Introduction to Real Analysis Wiley India Edition 2010
(18) B.Chaudhari and D.Somasundarm: Mathematical Analysis, Narosa Publishing House, New Delhi
(19) N.P.Bali , Real Analysis:Golden Math Series (2011)Publish by Firewall Media
(20) Walter Rudin; Principles of Mathematical Analysis, Mc Graw Hill Books Company, Third Edition 1976, international student edition.

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Semester- I**

**Code of the Course/Subject** **Title of the Course/Subject** **(Total Number of Periods/week)**

DSC-II / Mathematics Advanced Abstract Algebra 06

**COs:**

**On successful completion of this course, students would be able to**

- recall the concepts of coset and normal subgroup and to prove elementary propositions involving these concepts.
- recognize different types of subgroups such as normal subgroups, cyclic subgroups and understand the structure and characteristics of these subgroups.
- demonstrate the homomorphism, Sum and direct sum of ideals, maximal and prime ideals, nilpotent and nil ideals.
- translate the transition of important concepts of homomorphisms and isomorphisms from discrete Mathematics to advanced abstract Mathematics.
- interpret the Definition and examples of modules and Sub modules ,quotient modules, completely reducible modules and free modules.

| **Unit** | **Content** |
|---|---|
| Unit I | Normal Subgroups and quotient groups, Isomorphism theorems, Automorphisms, Conjugacy and G-sets, Normal series, Solvable groups, Nilpotent groups. **(14 Hrs.)** |
| Unit II | Permutation groups, cyclic decomposition, Alternating group An, Simplicity of An, structure theorems of groups, Direct products, Finitely generated abelian groups, invariants of a finite abelian group, Sylow theorems, Groups of order $p^2$, pq. **(15 Hrs.)** |
| Unit III | Ideals, Homomorphism, Sum and direct sum of ideals, Maximal and prime ideals, Nilpotent and Nil ideals, Zorn's lemma. **(15 Hrs.)** |
| Unit IV | Unique factorization domain, Principle ideal domain, Euclidean domain, Polynomial rings over UFD. **(14 Hrs.)** |
| Unit V | Modules- Definition and examples, Sub modules and direct sums, R-homomorphism and quotient modules, completely reducible modules, free modules. **(14 Hrs.)** |

**Text Book:**

1) V.K.Khanna and Bhambri ,A Course in Abstract Algebra , Vikas Publication House Pvt. Ltd. (2010).
2) P.B.Bhattacharya, S.K.Jani, S.R.Nagpaul, Basic Abstract Algebra

**Reference Books:**

1) I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2) M. Artin, Algebra, Pretice-Hall of India, 1991.
3) P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982,1989,1991.
4) N. Jacobson, Basic Algebra, Vols. I & II, W.H. Freeman, 1980.
5) S. Lang, Algebra, 3rd edition, Addison – Wesley, 1993.
6) I.S. Luthar and I.B.S. Passi, Algebra, Vol. I-Groups, Vol. II – Rings, Narosa Publishing House.
7) D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw-Hill, International Edition, 1997.
8) K.B. Datta, Matrix and Linear Algebra, Pretice Hall of India Pvt. Ltd., New Delhi, 2000.
9) S.K. Jain, A.Gunawadena and P.B. Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer – Verlag), 2001.
10) S. Kumarsena, Linear Algebra, a Geometric Approach, Prentice Hall of India, 2000.
11) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
12) I. Stewart, Galois Theory, 2nd Edition, Chapman and Hall, 1989.
13) J.P. Escofier, Galois Theory, GTM Vol.204, Springer, 2001.

14) T.Y. Lam, Lectures on Modules and Rings. GTM Vol.189, Springer Verlag, 1999.
15) D.S. Passman, A Course in Ring Theory, Wadsworth and Brooks/ Cole Advanced Books and Softwares, Pacific Groves, California, 1991.
16) J.A. Gallian, Contemporary Abstract Algebra, Narosa Publication.
17) A.R. Vashistha, Modern Algebra, Krishna Prakashan Media (P) Ltd.
18) John B. Fraleigh, a First Course in Abstract Algebra (Seventh Edition).
19) Abstract Algebra (Third Edition) By David S. Dummit, Richard M. Foote, Wilay India Edition.

**Programme: M.Sc.-I (Semester-I) , Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- I**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| DSC-III / Mathematics | Complex Analysis | 06 |

**COs:**

**On successful completion of this course, students would be able to**

- identify Cauchy integral formula apply to find the value of function at inside point of the region.
- express the function in series of positive and negative power of variable in a given region.
- record the concept of singularities to find integral of complex valued function on some simple connected region and multi connected region.
- apply the residue theorem to compute several kinds of real integrals.
- recognize about everywhere differentiable function and they will learn how it helps them to decide analyticity of function.

| **Unit** | **Content** |
|---|---|
| Unit I | Complex Integration : Power Series representation of analytic functions, Cauchy' s integral formula, higher order derivatives, Cauchy' s inequality , Zeros of Analytic function, Liouvilles theorem, Fundamental theorem of algebra. **(15 Hrs.)** |
| Unit II | Taylor's theorem, Maximum Modulus theorem, Morera's theorem, Counting of zeros, open Mapping theorem, Cauchy Goursat theorem, Schwarz's lemma. **(14 Hrs.)** |
| Unit III | Singularities, Isolated singularities, classification of isolated singularities, Laurent's series development, Casorti Wierstrass theorem, Argument principle, Rouche's theorem. **(14 Hrs.)** |
| Unit IV | Residue, Cauchy's residue theorem, Evaluation of integration by using residue theorem, Branches of many valued function (Specially arg z, log z, z), Hadamard's three circle theorem, Spaces of continuous functions, spaces of analytic functions, Hurwitz theorem. **(15 Hrs.)** |
| Unit V | Analytic continuation, uniqueness of direct analytic continuation, uniqueness of analytic continuation along a curve, power series method of analytic continuation, Schwartz reflection theorem, Weierstrass factorization principle. **(14 Hrs.)** |

**Text Book:**

1) J.B.Conway, Functions of One Complex Variable , Springer Verlag International Students Edition, Narosa Publishing House, 1980.
2) S.Ponnusamy Foundation of Complex Analysis , Narosa Publishing House, 1967.

**Reference Books:**

1) H. S. Kasana, Complex variables: Theory and Application, PHI Learning Pvt. Ltd., New Delhi.
2) Schaum's outline series Complex Analysis, Tata McGraw Hill Education Pvt. Ltd., New Delhi (2010).
3) J. N. Sharma, Complex Variables, Pragati Publication,Meerut.
4) A. R. Vashistha, Complex Variables, Krishna Publication.
5) Murray R. Spiegel, Seymour Lipschutz, Jon J. Schiller, Dennis Spellman., Schaum's outline series Complex Analysis, Tata McGraw Hill Education Pvt. Ltd., 3rd Edition, New Delhi 2010.
6) Walter Rudin, Real & Complex Analysis, McGraw Hill Book Co., 1966.
7) J. Ward Brown, Ruel V. Churchill, Complex variables and Application, McGraw Hill International Edition (2009).
8) H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
9) Liang-Shin Hahn & Bernhard Epstein, Classical Complex Analysis, Jones & Berlett Publishers. International London, 1996.
10) L. V. Ahlfors, Complex Analysis, McGraw Hill, 1979.
11) S. Lang, Complex Analysis, Addison Wesley, 1977.1998.
12) D. Sarason, Complex Function Theory, Hindustan Book, Agency, Delhi, 1994.
13) Mark J. Ablowitz and A. S. Fokar, Complex variables: Introduction & Application, Cambridge University Press, South Asian Edition, 56.
14) E. Hille, Analytic Function Theory (2 Vols), Gonn & Co. 1959.
15) W. H. J. Fuchs, Topics in the Theory of Function of Complex Variable, D. Van Nostrand Co., 1967.
16) C. Carathedory, Theory of Functions (2 Vols), Chelsea Publishing Company, 1964.
17) M. Heins, Complex Function Theory, Academic Press, 1968.
18) S. Saks & A. Zygmund, Analytic Functions, Monografie, Matematyczne, 1952.
19) E. C. Titchmarsh, the Theory of Functions, Oxford University Press, London.
20) W. A. Veech, A Second Course in Complex Analysis, W. A. Benjamin, 1967.
21) Complex variables and Applications, Jams Ward Brown, Ruel V. Churchill, McGraw Hill International Edition (2009).
22) Dennis G. Zill, Patrick D. Shanhan Jones and Burtlett, A First Course in Complex Analysis with application (Second edition) Publisher (2010).
23) John Mathew and Howell, Complex Analysis for Mathematician and Engineers.

**Programme: M.Sc. –I (Semester-I), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- I**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| DSC-IV / Mathematics | Topology –I | 06 |

**COs**

**On successful completion of this course, students would be able to**

- identify the cardinal and ordinal numbers and their role in building up the topology.
- demonstrate the concepts such as topological spaces ,open and closed sets, interior, closure and boundary.
- categories some important concepts like continuity, compactness, connectedness, projection mapping etc and prove related theorems.
- relates the basic concepts of countability axiom, separation axioms and convergence in topological spaces.
- distinguish between the regular , normal and completely regular spaces .

| **Unit** | **Content** |
|---|---|
| Unit I | Cardinal and Ordinal Numbers : Equipollent sets, cardinal numbers, order types, ordinal numbers, Axiom of choice. **(14 Hrs.)** |

| | |
|---|---|
| Unit II | Topological Spaces : Definition and examples of topological spaces. Open sets and Limit points. Closed sets and closure. operators and neighbourhoods. Bases and Relative Topologies. **(15 Hrs.)** |
| Unit III | Connectedness, Compactness and Continuity : Connected sets and components, compact and countably compact spaces. Continuous functions. Homeomorphisms. Arcwise connectivity . **(15Hrs.)** |
| Unit IV | Separation and Countability Axioms : T0, T1 & T2 spaces. T spaces and sequences. First and Second axiom spaces, separability. **(14 Hrs.)** |
| Unit V | Separation and Countability Axioms (Contd.): Regular and normal spaces, Completely regular spaces. **(14 Hrs.)** |

**Text Book:**

(1) William J. Pervin , Foundations of General Topology by, Publisher, Academic Press.

**References Books :**

(1) Semour Lipshutz , Theory and Problems of Set Theory and Related Topics , Publisher: Schaum Publishing Co., New York.
(2) J.R. Munkres, Topology : A First Course Publishers Prentice Hall of India.
(3) K.D.Joshi, Introduction to General Topology, Publisher , Wiley Eastern Ltd.
(4) R.S.Aggarwal ,A Text Book on Topology, Publisher : S.Chand & Company .
(5) J.N. Sharma, General and Algebric Topology, Krishna Prakashan, Meerut.

**Programme: M.Sc.-I (Semester-I), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- I**

**Code of the Course/Subject Title of the Course/Subject (Total Number of Periods/week)**

DSE-V / Mathematics Advanced Discrete Mathematics-I (Optional) 06

**COs**

**On successful completion of this course, students would be able to**

- design the graphs, paths, circuits, cycles and subgraphs.
- determine Circuit, Fundamental Circuit, cut sets, fundamental cut sets of the graph.
- illustrate chromatic number
- describe introductory computability theory its techniques.
- apply graph theory to grammars and languages .

| **Unit** | **Content** |
|---|---|
| Unit I | Graph Theory : Definition of (undirected) graphs, paths, circuits, cycles and subgraphs, Induced subgraphs, Degree of a vertex , Connectivity planar graphs and their properties, Trees, Euler formula for connected planar graphs, Complete and complete bipartite graphs, Kuratowski' s theorem (statement only) and its use. **(15 hrs.)** |
| Unit II | Graph Theory (Continue): Spanning trees, Circuit, Fundamental Circuit, cut sets, fundamental cut sets, and cycles, Minimal spanning trees and Kruskal's Algorithm, Matrix representations of graphs, Euler 's theorem on the existence of Eulerian paths and circuits, Directed graphs, Indegree and outdegree of a vertex, Weighted undirected graphs, Dijkstra' s algorithm, Strong connectivity and Warshall's algorithm. **(15 hrs.)** |
| Unit III | Chromatic Number: Chromatic Partitioning, Chromatic Polynomial, Matchings, Coverings, The Four Color Problem. **(14 hrs.)** |

| | |
|---|---|
| Unit IV | Introductory Computability Theory : Finite state machines and their transition table diagrams, Equivalence of finite state machines, Reduced machines, Homomorphism, Finite automata acceptors, Moore and Mealy machines. **(14 hrs.)** |
| Unit V | Grammars and Languages: Phrase structure grammars, Rewriting rules, Derivations, sentential forms, Language generated by a grammar, Regular, context free and context sensitive grammars and languages. **(14 hrs.)** |

**Text Book:**

1. N. Deo, Graph Theory with applications to Engineering and Computer Sciences, Prentice Hall of India.

2. J.P. Tremblay and R. Manohar , Discrete Mathematical Structure with Application to Computer Science, McGraw Hill Book Co. 1997.

**References Books:**

(1) Seymour Lipschutz, Finite Mathematics (International Edition 1983).McGraw Hill Book Company .

(2) S. Wiitala, Discrete Mathematics - A Unified Approach, McGraw Hill Book Co.

(3) J.L. Gersting : Mathematical Structure for Computer Science (3rd Edition), Computer Science Press, New York.

(4) C.L.Liu, Elements of Discrete Mathematics, McGraw Hill Book Co.

**Programme: M.Sc.-I (Semester-I), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**
**Programme : M.Sc.-I**

**Semester- I**

**Code of the Course/Subject** **Title of the Course/Subject** **(Total Number of Periods/week)**

DSE-V / Mathematics Differential Geometry (Optional) 06

**COs**

**On successful completion of this course, students would be able to**

- discuss the local intrinsic properties of a surface, curves on a surface, surfaces of revolution.
- design arguments in the geometric description of family of curves and surfaces in order to establish basic properties of geodesics.
- apply Geodesics theorem and restate the Gaussian Curvature, Surface of constant curvature, conformal and Geodesic mappings.
- recognize the tensor calculus, tensor product of vector spaces, transformation formulae, contraction special tensors, and inner product.
- apply covariant differentiation, of tensors and use absolute derivation of tensorial forms and tensor connexion.

| **Unit** | **Content** |
|---|---|
| Unit I | Local Intrinsic properties of a surface, Definition of surface, curves on a surface, surfaces of Revolution, Helicoids, Metric, Direction Coefficients. **(15 Hrs.)** |
| Unit II | Families of curves, Isometric correspondence, Intrinsic properties, Geodesics, Canonical Geodesic Equation, Normal Properties, Geodesic Existance theorems, Geodesic parallels. **(14 Hrs.)** |
| Unit III | Geodesic curvature, Gauss-Bonnet Theorem, Gaussian Curvature, Surface of constant curvature, conformal mapping, Geodesic mapping. **(14 Hrs.)** |
| Unit IV | Review of tensor calculus, Vector spaces, the dual space, Tensor product of vector spaces, Transformation formulae, contraction special tensors, Inner product. Associated tensors Exterior Algebra. **(14 Hrs.)** |

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|---|---|
| Unit V | Differential manifolds, Tangent vectors, Af fine Tensors and Tensorial forms, Connexions, covariant differentiation, Absolute derivation of Tensorial forms, Tensor connexions. **(15 Hrs.)** |

**Text Book:**

(1) T .J.Wilmore, An Introduction to Differential Geometry Oxford University Press (1959).

**References Books:**

(1) W .Klingenberg (Springer), A course in Differential Geometry.
(2) Weatherburn, C. Riemannian Geometry and Tensor Calculus.
(3) T. M. Karade, G.S. Khadekar, Maya S. Bendre, Lectures on General relativity, Sonu-Nilu Publication, 2004.
(4) D. Somasundaram, Differential Geometry a first course, Narosa Publishing House,2008.

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I ( Mathematics)**
**Semester- I**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| AEC on DSC-I / Mathematics | AEC on Real Analysis | 02 ( T) |

**COs:**

**On successful completion of this course, students would be able to**

- Create the interest to solving the problems and grasp new techniques.
- Analyze various concepts of Sequence and Series.

| | |
|---|---|
| Unit-I | Problems on; Sets, relation function, countable and uncountable sets, Archimedean property, completeness of R, Bolzano-Weierstrass theorem, ordered field, infinite limits and limits at infinity of a function, the epsilon-delta definition of continuity and the algebra of continuous functions, monotonic functions, types of discontinuities with examples. **(9 Hrs.)** |
| Unit-II | Problems on; Sequence and Series of function: Point-wise-convergent, Uniform Convergent, Cauchy Criterion for uniform convergence, Mn-Test, Uniform Convergence and continuity, Uniform Convergence and Differentiation, Uniform Convergence and Integration, Weierstrass M-Test, Abel's test and Dirichlet's test's for uniform convergence. **(9 Hrs.)** |

**Text Book:**

(1) Walter Rudin, Real and Complex Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

**References Books :**

(1) Apostol T .M., Mathematical Analysis, Narosa Publishing House,New Delhi, 1985.
(2) Eurl D.Rainville : Infinite series, The Macmillan Company , New York.
(3) Friedman A., Foundations of Modern Analysis, Holt Rinehart and Winston, Inc, New York, 1970.
(4) Hewitt E. and Starmberg, Real and Abstract Analysis, Berlin, Springer 1969.
(5) Jain P .K. and Gupta V. P., Lebesque Measure and Integration, New Age international (P) Ltd., Published, New Delhi, 1986, (Reprint2000)
(6) Gabriel Klambaucer , Mathematical Analysis Marcel Dekkar , Inc.,New York, 1975.
(7) Natanson I.P ., Theory of Function of real variables, Vol.-I, Frederick Ungar Publishing Co.1961.
(8) Parthasarathy K.R., Introduction to Probability and Measure,Macmillan Company of India, Delhi, 1977.
(9) Royden H.L., Real Analysis, Macmillian Pub. Co. Inc., 4th Edition,New York, 1993.
(10) R.R.Goldber g : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi - 1970.
(11) Serge Lang, Analysis I & II, Addison - Wesley Publishing CompanyInc., 1969.
(12) S.C.Malik and Savita Arora: Mathematical Analysis, Wiley Fastern Ltd., New Delhi.
(13) S.C.Malik and Savita Arora : Mathematical Analysis, New Age International (P.) Ltd.2010, Fourth Edition.
(14) Shani Narayan : A Course of Mathematical Analysis, S.Chand and Company, New Delhi.
(15) White A.J., Real Analysis, an introduction.

(16) Karade T .M. and Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, 2004.
(17) Robert ,G.Bartle,Donald R.Sherbert:Introduction to Real Analysis Wiley India Edition 2010.
(18) B.Chaudhari and D.Somasundarm: Mathematical Analysis, Narosa Publishing House, New Delhi.
(19) N.P.Bali ,Real Analysis:Golden Math Series (2011)Publish by Firewall Media.
(20) Walter Rudin; Principles of Mathematical Analysis, Mc Graw Hill Books Company, Third Edition 1976, international student edition.

**Programme: M.Sc. –I (Semester-II) , Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I (Mathematics)**

**Semester- II**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| DSC-I / Mathematics | Measure And Integration Theory | 06 |

**COs:**

**On successful completion of this course, students would be able to**

- analysis Lebesgue outer measure, regularity and Lebesgue measurability
- explain integration and non-negative function, the general integral, Riemann and Lebesgue integrals
- demonstrate the concepts of four derivatives, differentiation and integration
- discuss the measure and outer measure
- express completion of measure, measure spaces, Holder and Minkowski inequality

| **Unit** | **Content** |
|---|---|
| Unit I | Lebesgue outer measure, measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability. **(15 Hrs.)** |
| Unit II | Integration of Non-negative function, the general integral, integration of series, Riemann and Lebesgue integrals. **(14 Hrs.)** |
| Unit III | The Four derivatives, continuous non-differentiable functions, functions of bounded variation, Lebesgue differentiation theorem, differentiation and integration. **(15 Hrs.)** |
| Unit IV | Measures and outer measures, Extension of a measure, The Lp uniqueness of Extension, Completion of measure. **(14 Hrs.)** |
| Unit V | Measure spaces, integration with respect to a measure. spaces, convex functions, Jensen's inequality. Holder and Minkowski inequality. Completeness of convergence in measure. Almost Uniform convergence. **(14 Hrs.)** |

**Text Book:**

(1) G. de Barra, Measure Theory and Integration. Wiley Eastern Limited, 1981.

**References Books :**

(1) Bartle R.G ., The Elements of Integration, John Wiley & Sons, Inc.,New York, 1966.
(2) Halmos P .R. Measure Theory, Van Nostrand Princeton, 1950.
(3) Hawkins T. G., Lebesgue' s Theory of Integration, its origins and Development, Chelsea, New York, 1979.

(4) Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.
(5) Karade T .M., Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, Nagpur, 2004.
(6) Royden H.L., Real Analysis, Macmillan Pub. Co. Inc., 4th Edition,New York, 1993.
(7) P.K. Jain and V.K.Gupta, Leabegue Measure and integration, June 2010.

**Programme: M.Sc. –I (Semester-II), Mathematics**

**Syllabus Prescribed for the year 2022-23 , PG Programme**

**Programme : M.Sc.-I**

**Semester- II**

**Code of the Course/Subject Title of the Course/Subject (Total Number of Periods/week)**

DSC-II / Mathematics Advanced Linear Algebra and Field Theory 06

**COs:**

**On successful completion of this course, students would be able to**

- recall the concepts of eigen values , eigen vectors and polynomials.
- explain quadratic form, linear transformation, canonical and normal form.
- describe the concepts of algebraic extension of fields.
- discuss normal and separable extension of Group.
- understand the concepts of Galois theory and its application.

| Unit | Content |
|---|---|
| Unit I | Canonical forms: Eigen values and eigenvectors. The minimal polynomial, Diagonalizable and triangular operators, The Jordan form, The rational form. **(15 Hrs.)** |
| Unit II | Quadratic forms, Linear transformation, Congruence of matrices, Reduction of real quadratic form, Canonical or Normal form of a real quadratic form, Signature and index of a real quadratic form, Sylvester's law of inertia, Definite and semi-definite real quadratic Forms, Hermitian forms. **(15 Hrs.)** |
| Unit III | Algebraic extension of fields: Irreducible polynomials and Einstein criterion, Adjunction of roots, Algebraic extension, Algebraically closed fields. **(14 Hrs.)** |
| Unit IV | Normal and separable extension: Splitting fields, Normal extension, multiple roots, finite fields, Separable extension. **(14 Hrs.)** |
| Unit V | Galois theory and Applications: automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra, Roots of unity and cyclotomic polynomials, Cyclic extension, Polynomials solvable by radicals, Symmetric functions, Ruler and compass constructions. **(14 Hrs.)** |

**Text Book**:

1) P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul, Basic Abstract Algebra.
2) I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

**Reference Books:**

1) M. Artin, Algebra, Pretice-Hall of India, 1991.
2) P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
3) N. Jacobson, Basic Algebra, Vols. I & II, W.H. Freeman, 1980.
4) S. Lang, Algebra, 3rd edition, Addison – Wesley, 1993.
5) I.S. Luthar and I.B.S. Passi, Algebra, Vol. I-Groups, Vol. II – Rings, Narosa Publishing House.
6) D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw-Hill, International Edition, 1997.
7) K.B. Datta, Matrix and Linear Algebra, Pretice Hall of India Pvt. Ltd., New Delhi, 2000.
8) S.K. Jain, A.Gunawadena and P.B. Bhattacharya, Basic Linear Algebra with MATLAB,

Key College Publishing (Springer – Verlag), 2001.
9) S. Kumarsena, Linear Algebra, a Geometric Approach, Pretice Hall of India, 2000.
10) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
11) I. Stewart, Galois Theory, 2nd Edition, Chapman and Hall, 1989.
12) J.P. Escofier, Galois Theory, GTM Vol.204, Springer, 2001.
13) T.Y. Lam, Lectures on Modules and Rings. GTM Vol.189, Springer Verlag, 1999.
14) D.S. Passman, A Course in Ring Theory, Wadsworth and Brooks/ Cole Advanced Books and Softwares, Pacific Groves, California, 1991.
15) J.A. Gallian, Contemporary Abstract Algebra, Narosa Publication.
16) A.R. Vashistha, Modern Algebra, Krishna Prakashan Media (P) Ltd.
17) V.K. Khanna and Bhambri, a Cource in Abstract Algebra, Vikas Publication, House (P) Ltd. (2010).
18) John B. Fraleigh, a First Course in Abstract Algebra (Seventh Edition).
19) David S. Dummit, Richard M. Foote , Abstract Algebra (Third Edition) , Willey India Edition.
20) A.R. Vashistha and A. K. Vashistha, Matrices, Krishna Publication, Meerut.

**Programme: M.Sc.-I (Semester-II), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- II**

**Code of the Course/Subject** **Title of the Course/Subject** **(Total Number of Periods/week)**

DSC-III / Mathematics Integral Equations 06

**COs:**

**On successful completion of this course, students would be able to**

- understand the type of integral equations.
- categorize Volterra integral equations of first and second kinds.
- determine the solution of Fredholm integral equations of the second kinds.
- define the concepts of iterated kernels and reciprocals kernels.
- explain solution of Volterra integral equations of second kinds.

| **Unit** | **Content** |
|---|---|
| Unit I | Definition of integral equations, Types of integral equations: Fredholm integral equations of the first and second kind, homogeneous Fredholm integral equations of the second kind, Volterra integral equations of first and second kind, Homogeneous Volterra integral equations of the second kind, special kinds of kernels, symmetric kernels, separable and degenerate kernels, Leibnitz rule, solution of integral equations, solved examples, Method of converting an initial value problem into integral equations, solved examples, method of converting a boundary value problems into a Fredholm integral equations. Solved examples. **(14 Hrs.)** |
| Unit II | Eigen values and Eigen functions: (a) Solution of homogeneous Fredholm integral equations of the second kind with separable kernels, solved examples based on (a).<br><br>(b) Solution of Fredholm integral equation of the second kind with separable kernels, Solved examples based on (b). **(14 Hrs.)** |
| Unit III | Definition of iterated kernels or functions, definition of resolvent kernels or reciprocal kernel, solution of Fredholm integral equation of the second kind by successive substitutions, solution of Volterra integral equation of the second kind by successive substitutions, Neumann's series, some important theorems, determination of iterated kernels, determination of resolvent kernels for Fredholm integral equations, solution of Fredholm integral equation with the help of resolvent kernels, solution of Fredholm integral equations by method of successive approximation to find solutions up to third order. Solve examples. **(15 Hrs.)** |
| Unit IV | Solution of Volterra integral equations of second kind, determination of resolvent kernels for Volterra integral equations, solution of Volterra integral equations with the help of the resolvent kernels, solved examples, Neumann's series, Method of successive approximation for solving Volterra integral equations of second kind, Volterra integral equations of first kind , solution of Volterra integral equations |

| | |
|---|---|
| | of the first kind, solved examples, some fundamental properties of Eigen values and Eigen functions for symmetric kernels. **(15 Hrs.)** |
| Unit V | Applications of integral equations and Green's function to ordinary differential equations, definition of Green's functions, Important theorems, constructions of Green's functions, solved examples, solution of boundary value problems using Green's functions, solved examples, solution of boundary value problems using Green's functions, solved examples, the case of homogeneous and conditions of boundary value problems. **(14 Hrs.)** |

**Text Book:**

1) M. D. Raisinghania, Integral equations and boundary value problems, S. Chand Publication.

2) Shanti Swaroop, Shiv Raj Singh, Integral equations.

**Reference books:**

1) R.P. Kanwal, Linear Integral Equation, Theory and Techniques, Academic Press, N.Y. (1971).
2) S.G. Mikhlin, Linear Integral Equations, Hindustan Book Agency, (1960).
3) A.M. Viazwaz, A First Course in Integral Equations, World Scientific (1997).
4) L.I.G. Chambers, Integral Equation: A Short Course, International Text Book Company Ltd. (1976).
5) Larry Andrews, Bhimsen Shiramoggo, Integral Transform for Engineers, Prentice Hall of India (2003).

**Programme: M.Sc.-I (Semester-II), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- II**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| DSC-IV / Mathematics | Topology–II | 06 |

**COs:**

**On successful completion of this course, students would be able to**

- categorize some important concepts of metric spaces.
- restate the ideas and concepts of complete metric spaces.
- interpret the definition and examples of product spaces.
- express the function and quotient spaces.
- discuss the metrization and paracompactness.

| **Unit** | **Content** |
|---|---|
| Unit I | Metric Spaces : Metric Spaces as topological spaces. Topological properties. Hilbert ($L_2$) space. Frechet space. Space of continuous functions. **(14 Hrs.)** |
| Unit II | Complete Metric Spaces: Cauchy sequences, completions, Equivalent conditions, Baire category Theorem. **(14 Hrs.)** |
| Unit III | Product Spaces: Finite Products, product invariant properties. Metric Products. Tichonov Topology, Tichonov Theorem. **(15 Hrs.)** |
| Unit IV | Function and Quotient Spaces: Topology of pointwise convergence. Topology of compact convergence. Quotient topology. **(14 Hrs.)** |

| | |
|---|---|
| Unit V | Metrization and Paracompactness: Urysohn's metrization theorem, paracompact spaces, Nagata-Smirnov metrization theorem. **(15 Hrs.)** |
| | |

**Text Book:**

(1) William J. Pervin , Foundation of General Topology, Publisher: Academic Press.

**Reference Books :**

(1) S.R.Munkres, Topology: A First Course, Publisher : Prentice Hall of India.

(2) K.D.Joshi Introduction to General Topology, Publishers : WileyEastern Ltd.

**Programme: M.Sc.-I (Semester-II), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- II**

**Code of the Course/Subject Title of the Course/Subject (Total Number of Periods/week)**

DSE-V / Mathematics Advanced Discrete Mathematics-II (Optional) 06

**COs:**

**On successful completion of this course, students would be able to**

- develop the logical tools among the students.
- interpret the concepts of Semigroups and Monoids.
- categorize the concepts of Lattice and sublattice.
- apply the Boolean algebra to switching circuits.

| **Unit** | **Content** |
|---|---|
| Unit I | Formal Logic: Statements, symbolic representation and Tautologies. Quantifiers, Predicates and validity. Propositional logic. **(14 hrs.)** |
| Unit II | Semigroups and Monoids : Definitions and examples of semigroups and monoids (including those pertaining to concatenation operation). Homomorphism of semigroups and monoids. Congruence relation and Quotient semigroups. Subsemigroups and submonoids. Direct products. Basic Homomorphism theorem. **(14 hrs.)** |
| Unit III | Lattice Theory : Lattices are partial ordered sets. Their properties. Lattices as algebraic systems. Sublattices. Direct products and Homomorphisms. Some special lattices, e.g. complete, complemented and distributive lattices. **(15 hrs.)** |
| Unit IV | Boolean Algebras : Boolean algebra as a lattice. Various Boolean identities. The switching algebra examples. Subalgebras. Direct products and Homomorphisms. Joint irreducible elements. **(14 hrs.)** |
| Unit V | Boolean Algebras (Continue) :Atoms and minterms. Boolean forms and their equivalence. Minterm Boolean forms. Sum of products. Canonical forms. Minimization of Boolean functions. Applications of Boolean algebra of switching theory .(Using AND, OR and NOT gates). **(15 hrs.)** |

**Text Book:**

(1) J.R.Tremblay and R. Manohar , Discrete Mathematical Structure with Application to Computer Science, McGraw Hill Book Co., 1997

(2) N.Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India.

**References Books :**

(1) J.E. Hopcroft and J.D.Ullman, Introduction to Automata Theory, Language and Computation, Narosa Publishing House.

(2) C.L. Liu, Elements of Discrete Mathematics, McGraw Hill Books co.

(3) F.H. Harary - Graph Theory, Narosa Publishers, New Delhi (1989)

(4) K.R.Parthasarthy , Basic Graph Theory (TMH)

**Programme: M.Sc. –I (Semester-II), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- II**

| **Code of the Course/Subject** | **Title of the Course/Subject** | **(Total Number of Periods/week)** |
|---|---|---|
| DSE-V / Mathematics | Riemannian Geometry (Optional) | 06 |

**COs:**

**On successful completion of this course, students would be able to**

- discuss the properties of Christoffel symbols, divergence, gradient and Laplacian.
- demonstrate the concepts of parallel vector field.
- interpret the concepts of curvature tensor.
- categorize some concepts like Ricci tensor, curvature invariant and Einstein tensor.
- summarize the concepts of Riemannian curvature , space of constant curvature, intrinsic symmetric and killing vectors.

| **Unit** | **Content** |
|---|---|
| Unit I | Riemannian metric, metric tensor , Christoffel symbol, Christoffel symbol of first kind, second kind, properties of Christoffel symbols. Computations of Christoffel's symbols for static and non-static spherically symmetric and R-W spacetimes , transformation of Christoffel symbols, derivatives of tensor, absolute derivative. Covariant derivatives, divergence, gradient, Laplacian. **(15 Hrs.)** |
| Unit II | Parallel Vector Fields: Parallel vector field of constant magnitude, parallel displacement of covariant vector field, parallelism of a vector field of variable magnitude Geodesic, Differential equations of a geodesic, special co-ordinate system , Local Cartesians, Riemannian co-ordinates, Normal co-ordinates, Geodesic normal co-ordinates. **(14 Hrs.)** |
| Unit III | Curvature Tensor : Covariant curvature tensor of Riemann tensor , curvature tensor in Riemannian co-ordinates, properties of curvature tensors, on a cyclic property, number of independent components of R. **(14 Hrs.)** |
| Unit IV | Ricci tensor, curvature invariant, Einstein tensor, Computations of Einstein's tensor for static and non-static spherically symmetric and R-W space times, the Bianchi identity. Geodesic deviation : Equations of Geodesic deviation. **(14 Hrs.)** |
| Unit V | Riemannian curvature, space of constant curvature, flat space, tensor derivatives, dual tensors, intrinsic symmetries and killing vectors. **(14 Hrs.)** |

**Text Book:**

(1) T. J. Willmore , An Introduction in Differential Geometry, Dover Publication, London, 2012

**Reference Books :**

(1) J. L. Synge, Tensor Calculus – Schild.
(2) C.E. Weatherburn, An introduction to Riemannian geometry and tensor calculus, Cambridge university press, (1963)
(3) L.P. Eisenhard, Riemannian geometry, University press Princeton (1926)
(4) J.A. Schouten, Ricci Calculus, Springer Verlag, Berlin
(5) T.Y. Thomas, Concepts from tensor analysis and differential geometry, Academic press, New York
(6) W. Boothby, Introduction to differentiable manifold and Riemannian geometry, Academic press, 1975
(7) S. Kobayashi and K. Nomizu, Foundations of differential geometry, Vol. I and II Wiley Interscience publisher 1963 (Vol.I), 1969 (Vol. II)
(8) T.M.Karade, K.S.Adhav, V.G.Mete, A.S.Nimkar, S.N.Bayaskar,M.S.Bendre, Elements of Riemannian Geometry, Sonu Nilu Einstein Foundation, International, 2022.

**Programme: M.Sc.-I (Semester-II), Mathematics**

**Syllabus Prescribed for the year 2022-23, PG Programme**

**Programme : M.Sc.-I**

**Semester- II**

**Code of the Course/Subject Title of the Course/Subject (Total Number of Periods/week)**

AEC on DSC-II / Mathematics AEC on Advanced Linear Algebra and Field Theory 02 (T)

**COs:**

**On successful completion of this course, students would be able to**

- understand the concepts of Advanced Linear Algebra
- develop the mental ability to solve the problems.

| Unit | Content |
|---|---|
| Unit I | Examples and Properties of eigen values and eigen vectors, minimal polynomial with examples, relation of algebraic multiplicity and geometric multiplicity with examples, Examples of diagonalizable matrices, problems on Jordon- Canonical forms, Examples of Quadratic forms. |
| Unit II | Examples of extension fields, problems on reducible and irreducible polynomial, various test for irreducible polynomial, properties with examples of finite fields, Roots of unity. |

**Text Book**:

1) P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul, Basic Abstract Algebra.
2) I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

**Reference Books:**

1) N. Jacobson, Basic Algebra, Vols. I & II, W.H. Freeman, 1980.
2) K.B. Datta, Matrix and Linear Algebra, Pretice Hall of India Pvt. Ltd., New Delhi, 2000.
3) S.K. Jain, A.Gunawadena and P.B. Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer – Verlag), 2001.
4) S. Kumarsena, Linear Algebra, a Geometric Approach, Pretice Hall of India, 2000.
5) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
6) J.A. Gallian, Contemporary Abstract Algebra, Narosa Publication.

7) A.R. Vashistha, Modern Algebra, Krishna Prakashan Media (P) Ltd.

8) V.K. Khanna and Bhambri, a Cource in Abstract Algebra, Vikas Publication, House (P) Ltd. (2010).

9) A.R. Vashistha and A. K. Vashistha, Matrices,Krishna, Publication, Meerut.

# General Scheme

**Sant Gadge Baba Amravati University Amravati**

**Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Mathematics)**

**(Two Years ... Four Semesters Degree Course- C.B.C.S)**

**(M. Sc. Part-I) Semester- I**

| S. N. | Subject | Subject Code | Teaching & Learning Scheme | | | | | | | Duration Of Exam Hours | Examination & Evaluation Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Maximum Marks | | | | | Minimum Passing | |
| | | | Teaching Period Per Week | | | | Credits | | | | Theory | | Practical | | Total Marks | | |
| | | | L | T | P | Total | L/T | Practical | Total | | Theory+ MCQ External | Theory Internal | Internal | External | | Marks | Grade |
| 1 | DSC I (MTH-1) | | 4 | - | - | 4 | 4 | - | 4 | 3 | 80 | 20 | | | 100 | 40 | P |
| | AEC on DSCI (MTH-1) | | - | 2 | - | 2 | 2 | - | 2 | 2 | 40 | 10 | - | - | 50 | 20 | P |
| 2 | DSC II(MTH-2) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 3 | DSC-III (MTH-3) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 4 | DSC IV (MTH-4) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 5 | DSE V (MTH-5 or MTH-6) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 6 | **#Internship/Field Work/Work Experience@** | | | | | | | | | | | | | | | | |
| 7 | **Open elective/ GIC/Open skill course/MOOC*** | | | | | | | | | | | | | | | | |
| | **TOTAL** | | | | | 30 | | | 30 | | | | | | | | |

**L: Lecture, T: Tutorial, P: Practical**

# Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Mathematics) according to their convenience; @ denotes Non-Examination/Ancillary Credit

**Note : Internship /Apprenticeship/Field Work / Work Experience (During vacations of Semester I to Semester III) for duration of minimum 60 hours to maximum 90 hours mandatory to all the students, to be completed during vacations of Semester I to III. This will carry 2 Credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.**

**- OEC (Optional) can be studied during semester I to IV**

# General Scheme

**Sant Gadge Baba Amravati University Amravati**

**Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Mathematics)**

**(Two Years ... Four Semesters Degree Course- C.B.C.S)**

**(M. Sc. Part-I) Semester- II**

| S. N. | Subject | Subject Code | Teaching & Learning Scheme | | | | | | | Duration Of Exam Hours | Examination & Evaluation Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Teaching Period Per Week | | | | Credits | | | | Maximum Marks | | | | | Minimum Passing | |
| | | | | | | | | | | | Theory | | Practical | | Total Marks | | |
| | | | L | T | P | Total | L/T | Practical | Total | | Theory+ MCQ External | Theory Internal | Internal | External | | Marks | Grade |
| 1 | DSC I (MTH-7) | | 4 | - | - | 4 | 4 | - | 4 | 3 | 80 | 20 | | | 100 | 40 | P |
| 2 | AEC on DSC I (MTH-7) | | - | 2 | - | 2 | 2 | - | 2 | 2 | 40 | 10 | - | - | 50 | 20 | P |
| 3 | DSC II(MTH-8) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 4 | DSC-III (MTH-9) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 5 | DSC IV (MTH-10) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 6 | DSE V (MTH-11 or MTH-12) | | 6 | - | - | 6 | 6 | - | 6 | 3 | 80 | 20 | | | 100 | 40 | P |
| 7 | **#Internship/Field Work/Work Experience@** | | | | | | | | | | | | | | | | |
| 8 | **Open elective/ GIC/Open skill course/MOOC*** | | | | | | | | | | | | | | | | |
| | **TOTAL** | | | | | 30 | | | 30 | | | | | | | | |

**L: Lecture, T: Tutorial, P: Practical**

# Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Mathematics) according to their convenience; @ denotes Non-Examination/ Ancillary Credit