Sant Gadge Baba Amravati University, Amravati
Syllabus for B.Sc. III (Mathematics) Sem V & Sem VI (CBCS)
Session 2024-25

Faculty: Science and Technology

Programme: B. Sc. III (Mathematics)

POs:

At the end of the programme, graduates would be able to

1. Enhance the knowledge of student in all basic sciences.
2. Identify, formulate and develop solutions to computational challenges.
3. Develop scientific temper and think in a critical manner.
4. Build up progressive and successful career in academics, industry and society.
5. Develop students abilities and aptitudes to apply the mathematical ideas.

PSOs :

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

1. Understand major concepts in all disciplines of Mathematics
2. Formulate and develop Mathematical arguments in a logical manner
3. Gain good knowledge and understanding in advanced Mathematics
4. Create an awareness of the impact of Mathematics on the environment, society and development outside the scientific community.
5. Create sensitivity towards environmental concerns and contribute in the development of nation

Employability Potential of the Programme:

Career options for B.Sc. Mathematics students is not just limited to solving complex equation. Apart from the traditional career route of academics and research, there are many careers options offer for B.Sc. Mathematics students that can pick up banking, corporate, accounting and even teaching as their career option on completion of B.Sc. Mathematics, even a career in medicine and law is possible for Mathematics Honors student. Also, a degree with Mathematics is even financially supporting for students because they help in landing placement opportunities by giving an edge over students with B.Sc. physics or other major.

After completing B.Sc. Mathematics, a student can either decide to go for higher studies or apply for jobs. In the case of B.Sc. Mathematics Honors, both the options are very promising. After the B.Sc. Mathematics course, students can purse M.Sc. Mathematics and follow it up with an M. Phil or Ph.D. Students can become a mathematician doing research and also become a assistant professor. Also students can pursue a B. Ed. and become a school teacher. Moreover, student can work in related field which required mathematical skills (Machine learning, Data Science etc.). Thus, there exist innumerable B.Sc. Mathematics career options.

The best way to get a prestigious government job is through competitive exams. Exams like UPSC, Railways, and Commission etc. are some important competitive exams that one need to consider as portals for B.Sc. Mathematics career options

Syllabus Prescribed from the year 2024-25, UG Programme

Programme: B.Sc. III (Mathematics) CBCS

Semester- V

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
DSC-IX / Mathematics	Mathematical Analysis	**9+1***

Cos: After completing this course, students would be able to

1. To learn Analytic function and Harmonic function.

2. To understand Mobius transformation.

3. To understand fundamental theorem of integral calculus.

4. To learn various tests of convergence of Improper Integral.

5. To understand metric space, open and closed sets.

Unit	**Content**
Unit I	Continuity and differentiability of complex function, Analytic function, Cauchy-Riemann equations, Harmonic and conjugate functions, Milne-Thomson method. **(12 periods**)
Unit II	Elementary function, Mapping by elementary function, Mobius transformation, Fixed point, Cross ratio, Inverse and critical points, Conformal mapping. (**12 periods)**
Unit III	Riemann Integral: Integrability of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorem of integral calculus. **(12 periods)**
Unit IV	Improper integrals and their convergence, Comparison and limit tests. **(12 periods)**
Unit V	Metric spaces: Definition and examples of metric spaces, Neighbourhood, Limit point, Interior point, Open and Close sets, Cauchy sequences. **(12 periods)**
Activities (Internal)	1. Unit Test 2. Seminar/Group Discussion 3. Open Book Test /Quiz/ Study Tour/Project Assignments

* For the subject Mathematics, the strength of a batch of tutorials for UG classes shall be of 16 (Sixteen) with an addition of 10 percent with the permission of Honourable Vice Chancellor (As amended by Executive council dated 27/28-04-1979).

Text Book :

A Text Book of Mathematical Analysis: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari, Dnyanpath Publication, Amravati, Second edition 2024.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude : A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.

2] T. M. Karade, J. N. Salunke, M. S. Bendre, S. N. Bayaskar, S. A. Salve, S. B. Khobragade : Elements of Mathematical Analysis, Sonu-Nilu Publication, Nagpur, 2024.

3] R. R. Goldberg: Methods of Real Analysis, Oxford IBH publishing Co. New Delhi, 1970.

4] Walter Rudin: Principles of Mathematical Analysis, International students edition (Third edition)

5] T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.,

6] S. Lang : Undergraduate Analysis, Springer-Verlag New York, 1983.

7] D. Somasundaram & B. Choudhari : A First Course in Mathematical Analysis, New Delhi. 1997.

8] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.

9] P. K. Jain & S. K. Kaushik : An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2000.

10] R. V. Churchiln and J.W.Brown, Complex Variables and Applications, 5th Edition, McGraw Hill, New York,1990

11] Mark J Ablowitz and : A.S. Fokas, Complex Variable Introduction and Application ,Cambridge University Press, South Asian Edition ,1998.

12] Shanti Narayan : Theory of functions of Complex Variable,,S.Chand and Co. New Delhi.

13] E.T.Coption,:Metric Spaces, Cambridge University Press ,1968.

14] P.K.Jain and K.Ahmed ,:Metric Spaces ,Narosa Publishing House, New Delhi 1996.

15] G.F.Simmons :Introduction to Topology and Modern Analysis, McGraw Hill, New York,1963.

16] Murray R. Spiegel : Theory and Problems of Advanced Calculus, Schaum Outline Series.

17] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.

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Programme: B.Sc. III (Mathematics) CBCS

Semester- V

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
DSC-X / Mathematics	Mathematical Methods	**9+1***

Cos: After completing this course, students would be able to

1. To learn Legendre's polynomials, recurrence formulae and Rodrigue's formula,
2. To solve Bessel's equation and study Recurrence formulae.
3. To study Fourier sine and cosine series
4. To study Laplace transform and its properties.
5. To study Fourier transform and its properties.

Unit	**Content**
Unit I	Legendre's equation, Legendre's polynomials, generating function of $P_n(x)$, recurrence formulae for $P_n(x)$, Orthogonality of Legendre's polynomial, Rodrigue's formula. **(12 periods)**
Unit II	Bessel's equation, Solution of Bessel's equation, Generating function for $J_n(x)$, Recurrence formulae for $J_n(x)$. **(12 periods)**
Unit III	Fourier series, Fourier series for odd and even functions, half-range Fourier sine and cosine series. (**12 periods)**
Unit IV	**Laplace transform**: Laplace transform of some elementary functions, Existence of Laplace transform, Properties of Laplace transform, Laplace transform of derivatives and integrals, Multiplication of t^n and division by t, Inverse Laplace transform, Convolution property. **(12 periods)**
Unit V	**Fourier Transform**: Finite Fourier sine transform; Inverse finite Fourier sine transform and cosine transform, Infinite Fourier transform, Infinite Fourier sine transform and cosine transform, Properties of Fourier transform. **(12 periods)**
Activities (Internal)	1. Unit Test 2. Seminar/Group Discussion 3. Open Book Test /Quiz/ Study Tour/Project Assignments

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Text Book :

A Text Book of Mathematical Methods: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, Dnyanpath Publication, Amravati, Second edition 2024.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.
2] T. M. Karade, N. T. Karade, V. G. Mete, I. D. Pawade, K. R. Muley, Minakshi T. Sarode: Mathematical Methods, Sonu- Nilu Publication, Nagpur, 2024.
3] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.
4] A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd., London.
5] Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.
6] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
7] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.
8] Goel and Gupta : Integral Transforms, Pragati Prakashan, Meerut.
9] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.

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Programme: B.Sc. III (Mathematics) CBCS

Semester- V

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
Practical / Mathematics	Mini-Project Phase-I	03

COs:

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

- aware about the survey of literature.
- related to real world problems through mathematical modelling.
- formulate the problem and apply the suitable techniques for solution
- write the dissertation /Project

Semester-V	**Particulars**	**System of marks and Credit**			
Mini-Project on any innovative topic		**Maximum Marks**		**Total Credit**	**Minimum Passing**
		Practical Internal	**Practical External**		
Mini-Project Phase-I	Submission	20	---	1.125	25
	Presentation	20	---		
	Viva-voce	10	---		
	Total Marks	**50**		**1.125**	**25**

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Programme: B.Sc. III (Mathematics) CBCS

Semester- VI

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
DSE -I / Mathematics	Linear Algebra (Optional)	**9+1***

COs: After completing this course, students would be able to

1. To learn the concept of Vector space, Subspace and Dimension.

2. To study Linear transformation and Rank nullity theorem.

3. To learn Dual space, Bidual space, Eigen value and eigen vectors.

4. To learn Cauchy- Schwarz inequality, Bessel's inequality and Gram Schmidt orthogonalization process.

5. To study Modules, homomorphism and isomorphism theorem.

Unit	**Content**
Unit I	**Vector space**: Definition and example of vector spaces, subspaces, sum and direct sum of subspaces, linear span, linear dependence, independence and their basic properties, basis, finite dimensional vector spaces, existence theorem for bases, invariance of the number of elements of a basis set, dimension. **(12 periods**)
Unit II	**Linear transformations**: Linear transformation and their representation as matrices, algebra of linear transformations, rank-nullity theorem, change of basis. **(12 periods)**
Unit III	**Dual Spaces**: Dual space, bidual space and natural isomorphism, adjoint of a linear transformation, Eigen values and eigen vectors of a linear transformation. **(12 periods)**
Unit IV	**Inner Product Spaces**: Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors, orthogonal complements, orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process. **(12 periods)**

Unit V	**Modules**: Modules, submodules, quotient modules, homomorphism and isomorphism theorems. **(12 periods)**
Activities (Internal)	1. Unit Test 2. Seminar/Group Discussion 3. Open Book Test /Quiz/ Study Tour/Project Assignments

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Text Book :

A Text Book of Linear Algebra: V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, N. S. Bayaskar, K. S. Wankhade, S. J. Chavhan, R. P. Rewaskar, Dnyanpath Publication, Amravati, Second edition 2024.

Reference Books :

1] T. M. Karade, Vidya N. Mahalle, V. D. Elkar, P. P. Khade, S. L. Munde, A. S. Bansod: Introductory Linear Algebra, Sonu Nilu Publication, Nagpur. 2024.
2] I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi,1975.
3] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman,1980 (Hindustan Publishing Co.).
4] Shanti Narayan : A Text Book Of Modern Abstract Algebra, S. Chand and Co., New Delhi.
5] K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
6] P. B. Bhattacharya, S. K. Jain and S. R. Nagpal : Basic Abstract Algebra (IInd Edition) Cambridge University Press Indian Edition,1997.
7] K. Hoffman and R. Kunze, : Linear Algebra ,IInd Edition Prentice Hall, Englewood Cliffs, New Jersey,1971.
8] S. K. Jain, A Gunawardhana and P. B. Bhattacharya : Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
9] S. Kumaresan :Linear Algebra, A Geometric Approach, P Prentice Hall of India Pvt. Ltd. New Delhi, 2000
10] Vivek Sahai and Vikas Bisht : Algebra, Narosa Publishing House, 1997.
11] D. S. Malik, J. N. Mordeson and M. K. Sen : Fundamentals of Abstract Algebra ,McGraw Hill International Edition 1997.
12] Joseph A. Gallian : Contemporary Abstract Algebra, Narosa publishing house.
13] P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul : First Course in Linear Algebra.
14] V. Krishnamurty, V. P. Mainru, J. L. Arrora : An Introduction to Linear Algebra.

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Programme: B.Sc. III (Mathematics) CBCS

Semester- VI

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
DSE -I / Mathematics	Number Theory (Optional)	**9+1***

COs: After completing this course, students would be able to

1. Familiar with Fundamental concepts of Number theory

2. To apply Euclid's algorithm and backwards substitution.

3. Add and subtract integers, modulo n, multiply integers and calculate powers.

4. Determine multiplicative inverses, modulo n and use to solve linear congruences.

5. To perform numerical computations with the Euler's phi function.

Unit	**Content**
Unit I	Fermat Numbers, Fermat's theorem, Wilsons theorem, Fermat kraitchik Factorization Method. **(12 periods**)
Unit II	Linear Diophantine equation, The mobius inversion formula, The greatest integer function, An application to the calendar. Pythagorean triplet. **(12 periods)**
Unit III	Special divisibility test, linear congruences, Chinese remainder theorem. **(12 periods)**

Unit IV	Arithmetic functions, Euler's theorem, the τ *and* σ functions, Mobius μ function. **(12 periods)**
Unit V	Primitive roots, primitive roots for prime, polynomial congruences, The congruence $x^2 \equiv a \pmod{p}$, general quadratic congruence, quadratic residues. **(12 periods)**
Activities (Internal)	1. Unit Test 2. Seminar/Group Discussion 3. Open Book Test /Quiz/ Study Tour/Project Assignments

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Reference Books :

1] T. M. Karade, J. N. Salunke, K. D. Thengane, M. S. Bendre: Lectures on Elementary Number Theory, Sonu-Nilu publication 2005.
2 D. M. Burton: Elementary Number Theory, McGraw Hill, New Delhi, Seventh Edition 2009.
3] C.Y. Hsiung: Elementary Theory of Numbers, Allied Publishers Ltd.1992.
4] I. Niven, H. S. Zuckerman and H. L. Montgomery: An introduction to the Theory of Numbers, Wiley Student Edition, Fifth edition 2004.
5] K. H. Rosen: Elementary Number Theory and its Applications, Addison-Wesley, 1986.
6] K. Irland and M. Rosen: A Classical Introduction to Modern Number Theory, GTM Volume 84, Springer-Verlag 1972
7] G. A. Jones and I. M. Jones: Elementary Number Theory, Springer, 1998.
8] W. Slerpinski: Elementary theory of Number, North-Holland, 1988, Ireland.
9] K. Rosen and M. Rosen: A classical Introduction to Modern Number Theory, GTM Volume 94, Springer-Verlag, 1972.

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Programme: B.Sc. III (Mathematics) CBCS

Semester- VI

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

DSE –II / Mathematics Graph Theory (Optional) **9+1***

COs:

After completing this course, students would be able to

1. To learn graph and its types.

2. To learn about trees and its properties.

3. To study various circuits and representation of planer graph.

4. To study vector space associated with graph, Orthogonal vectors.

5. To learn various matrix and its relationship.

Unit	**Content**
Unit I	Graph. Application of graphs, finite and infinite graphs, incidence and degree, isolated vertex, pendent vertex and null graph, isomorphism, subgraphs, walks, path and circuits, connected graphs and components, Euler graph, operation on graphs, Hamiltonian paths and circuits. **(12 periods**)
Unit II	Trees, some properties of trees, pendent vertices in a tree, distance and centres in a tree, Rooted and binary trees, spanning trees. **(12 periods)**
Unit III	Fundamental circuits, Cutsets, Some properties of cutsets, all cutset in a graph, fundamental circuits and cutsets, connectivity and separability, planer graphs, Kurutowski's two graphs, different representation of planer graph. **(12 periods)**
Unit IV	Vector space associated with a graph, circuit and cutset subspaces, Orthogonal vectors and spaces, Intersection and joint of W_Γ and W_S. **(12 periods)**
Unit V	Incidence matrix, Submatrix of A(G), Circuit matrix, Fundamental circuit matrix B, Rank of B, an application to a switching network, cutset matrix, path matrix, Adjacency matrix, the relationship among A_f, B_f and C_f . **(12 periods)**

Activities (Internal)	1. Unit Test 2. Seminar/Group Discussion 3. Open Book Test/Quiz/ Study Tour/Project Assignments

* For the subject Mathematics, the strength of a batch of tutorials for UG classes shall be 16 (Sixteen) with an addition of 10 percent with the permission of Honourable Vice Chancellor (As amended by Executive council dated 27/28-04-1979)

Text Book :

A Text Book of Graph Theory: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, S.M. Shingane, P. B. Deshmukh, S.R. Kumbhare, A.Y. Shaikh, A. P. Wasnik, Dnyanpath Publication, Amravati, Second edition 2024.

Reference Books :

1] J. N. Salunke : Boolean Algebra and Graph Theory, Laxmi Publication, Akot.
2] Narsingh Deo: Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi.
3] Richard Johnson- Baugh : Discrete Mathematics, Macmillan Publishing Company 886,Third Avenue New York 10022.
4] Olympia Nicodemi : Discrete Mathematics, C. B. S Publ. and Distributors 485,Jain Bhavan Bholanath Nagar Shahadara, New Delhi32 India.
5] Frank Harare : Graph Theory ,Narosa Publishing House, 307, Shiv Centre D.B.C. Sector Ku Bazar New Bombay 400704.
6] S. A. Choudum: A first Course in Graph Theory, McMillan India Ltd. Mercatile House Magazine Street Bombay 10.
7] E. L. LIU: Elements of Discrete Mathematics, McGraw Hill Book Company, New York.
8] Seymour Lipschiutz and Marc Lipson: Discrete Mathematics, TMH New Delhi (Schaum Outline series) IInd Edition.

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Programme: B.Sc. III (Mathematics) CBCS

Semester- VI

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
DSE –II / Mathematics	Special Theory of Relativity (Optional)	**9 + 1 ***

COs:

After completing this course, students would be able to

1. To study Lorentz transformation and its geometrical interpretation.

2. To learn two laws of thermodynamics for a moving system.

3. To study geometrical representation of space-time and various tensors.

4. To learn energy momentum tensor and transformation equation.

5. To study Maxwell's equation of electromagnetic theory.

Unit	**Content**
Unit I	**Review of Newtonian Mechanics:** Inertial frames, Speed of light and Galilean relativity, Relative character of space and time, Postulates of Special theory of relativity, Lorentz Transformation and its geometrical interpretation. Group properties of transformation. **(12 periods**)
Unit II	**Relativistic Kinematics:** Composition of parallel velocities, Length contraction, Time Dilation, Transformation equation for components of velocities and acceleration of a particle, Lorentz contraction factor, The thermodynamics of moving systems: The two laws of thermodynamics for a moving system, The Lorentz transformation for thermodynamics quantities a) volume and pressure b) energy c) work d) heat e) entropy f) temperature.**(12 periods)**
Unit III	**Geometrical Representation of Space-Time:** Four dimensional Minkowskian space-time of relativity, Time like and space like intervals, Proper time, World line, Four vectors and tensors in Minkowskian space-time, Past, Present and future null cone, Basic tensors, Covariant, Contravariant, Mixed, Operations on tensors, Outer product, Inner product, Quotient law. **(12 periods)**

Unit IV	**Relativistic Mechanics:** Variation of mass velocity, Equivalence of mass and energy, Transformation equations for mass, momentum and energy, Relativistic force and transformation equations for its components, The energy momentum tensor. **(12 periods)**
Unit V	**Electromagnetism:** Maxwell's equation of electromagnetic theory in vacuum, Propagation of electric and magnetic field strengths, Scalar and vector potential, Transformation of electromagnetic four potential vector, Transformation of charged density and current density, Lagrangian for a charged particle in electromagnetic field, The force on a moving charged, Lorentz force, Gauge transformation, Four-dimensional formulation of the theory, Maxwell's equation in tensor form, transformation for electric and magnetic field strength, energy momentum tensor of the electromagnetic field, Component of T^{ij} in term of electric and magnetic strength. **(12 periods)**
Activities (Internal)	1. Unit Test 2. Seminar/Group Discussion 3. Open Book Test /Quiz/ Study Tour/Project/Assignments

* For the subject Mathemsatics, the strength of a batch of tutorials for UG classes shall be 16 (Sixteen) with an addition of 10 percent with the permission of Honourable Vice Chancellor (As amended by Executive council dated 27/28-04-1979)

Text Book :

A Text Book of Special Theory of Relativity: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, V. J. Gaikwad, K. R. Mule, C. S. Khodre, A. R. Gupta, Dnyanpath Publication, Amravati, Second edition 2024.

Reference Books :

1] T. M. Karade, M. S. Bendre, V. P. Kadam, A. S. Nimkar, Prachi R. Agrawal, V. D. Bokey: Elements of Special Relativity, Sonu Nilu Publication, Nagpur, 2024.
2] J.K.Goyal & K. P. Gupta: Theory of Relativity, Krishna Prakashan, Meerut.
3] C. Molar : The Theory of Relativity, Oxford Clarendon Press, 1952.
4] P. G. Bergman : Introduction to The Theory of Relativity, Prentice Hall of India,Pvt.Ltd.1969.
5] J. L. Anderson : Principles of Relativity Physics, Academic Press, 1967.
6] V. A. Ugarov : Special Theory of Relativity, Mir Publishers, 1979.
7] R. Resnick : Introduction to Special Relativity Wiley Eastern, Pvt.Ltd.1972.

Syllabus Prescribed from the year 2024-25, UG Programme

Semester- VI

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods/week)**
Practical / Mathematics	Mini-Project Phase-II	03

COs:

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

- aware about the survey of literature.
- related to real world problems through mathematical modelling.
- formulate the problem and apply the suitable techniques for solution
- write the dissertation /Project

Semester-V	**Particulars**	**System of marks and Credit**			
Mini-Project on any innovative topic		**Maximum Marks**		**Total Credit**	**Minimum Passing**
		Practical Internal	**Practical External**		
Mini-Project Phase-II	Submission	20	---	1.125	25
	Presentation	20	---		
	Viva-voce	10	---		
	Total Marks	**50**		**1.125**	**25**