RAJEEV GANDHI GOVT. POST GRADUATE COLLEGE, AMBIKAPUR, SURGUJA (CG), INDIA

UNDER GRADUATE COURSE
in
Mathematics
(Under NEP 2020)

Based on UGC Model Curriculum

Learning Outcomes based Curriculum Framework

FOR

BACHLOUR OF SCIENCE PROGRAMME
IN
MATHEMATICS

SESSION 2023-2024

VISION

- To be a global centre of excellence in mathematics for the growth of science and technology.

MISSION

- To provide quality education and research in Mathematics through updated curriculum,effective teaching learning process.
- To inculcate innovative skills, team-work, ethical practices among students so as to meet societal expectations.

Programme Outcome

The students will be able to demonstrate ability –

1.To understand concept and theory of their respective subject.
2.To express thoughts and ideas effectively in writing and orally.
3.To identify relationship within and across disciplines in the sciences.
4.To cognitive and technical skills in their field and in multidisciplinary context.
5. To select and use relevant methods and tools for problem solving .
6. To make judgment and take decisions, based on analysis of data and evidence.
7. To critically evaluate principles and theory of sciences . in digital literacy and data analysis.
8. To find a job in their field, exercise responsibilities to job assigned and start-up a business .
9. To develop a sense of respect and duty towards constitutional, human and moral and professional values .
10 to mitigating the effects of environmental degradations, Climate change and pollution.

Graduate Attributes

The graduates should be able to demonstrate the capability to:

Disciplinary Knowledge:

- comprehensive knowledge and understanding of their subject area, the ability to engage with different traditions of thought, and the ability to apply their knowledge in practice including in multi-disciplinary or multi-professional contexts.

Problem solving

- Solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

Critical thinking:

- apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, beliefs, and there liability and relevance of evidence,
- identify relevant assumptions or implications ;and formulate coherent arguments.

Creativity

- create, perform ,or think in different and diverse ways about the same objects or scenarios,
- deal with problems and situations that do not have simple solutions,
- innovate and perform tasks in a better manner,
- view a problem or a situation from multiple perspectives,
- think'out of the box'and generate solutions to complex problems in unfamiliar contexts, adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.

Communication Skills:

- listen carefully, read texts and research papers analytically, and present complex in formation in a clear and concise manner to different groups/audiences,
- express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media,
- confidently share views and express herself/himself,
- construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice,

  convey ideas, thoughts ,and arguments using language that is respectful and sensitive to gender and other minority groups.

Analytical reasoning/thinking

- evaluate the liability and relevance of evidence;
- Identify logical flaws in the argument soothers;
- Analyze and synthesize data from a variety of sources;

- Draw valid conclusions and support them with evidence and examples, and addressing opposing view points

Research-related skills:

- A keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions
- The ability to problem arise, synthesize and articulate issues and design research proposals,
- The ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data,and predict cause-and-effect relationships,
- The capacity to develop appropriate methodology and tools of data collection,
- The appropriate use of statistical and other analytical tools and techniques,
- The ability to plan, execute and report the result so fan experiment or investigation,
- The ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/in personal research work, regardless of the funding authority or field of study.

Coordinating/collaborating with others:

- Work effectively and respectfully with diverse teams,
- Facilitate cooperative or coordinate effort on the part of a group,
- Act together as a group or at remain the interest so far common cause and work efficiently as a member of a team

Learning how to learn' skills:

- acquire new knowledge and skills, including 'learning how to learn' skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/skill development/re skilling,work independently, identify appropriate resources required for further learning,
- acquire or generational skills and time management to set self-defined goals and targets with timelines.
- Inculcate a healthy attitude to be a lifelong learner

Digital and technological skills

- Use ICT in a variety of learning and work situations,
- access, evaluate, and use a variety of relevant information sources,

use appropriate software for analysis of data

Multicultural competence and inclusive spirit

- the acquisition of knowledge of the values and belief so multiple cultures and a global perspective to honor diversity,
- capability to effectively engage in a multicultural group/society and interact respectfully with diverse groups,
- capability to lead diverse team to accomplish common group tasks and goals.

Gender sensitivity and adopt gender-neutral approach, as also empathy to the less advantaged and the differently-able including those with learning disabilities.

Value inculcation

- embrace and practice constitutional, humanistic ,ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, non-violence, scientific temper, citizenship values,
- practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies,
- identify ethical issues related to work, and follow ethical practices, including avoiding unethical behavior such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights,
- recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
- Adopt objective, unbiased, and truthful actions in all aspects of work,

Instill integrity and identify ethical issues related to work, and follow ethical practices

Programme Specific Outcomes

The post graduates shall be able to realise the following specific outcomes by the end of program studies: On successful completion of the M.Sc. Mathematics programme a student

PSO-1	Will have a strong foundation in both pure and applied mathematics.
PSO-2	Will be able to apply mathematical skills for solving problems and for preparing various competitive exams.
PSO-3	Will be able to communicate mathematical knowledge effectively, in writing as well as orally.
PSO-4	Will identify applications of mathematics in other disciplines, leading to enhancement of career prospects in different fields and research areas.
PSO-5	Will have basic knowledge of programming and computational techniques as required for employment.
PSO-6	Should have the knowledge of the fundamental axioms in mathematics and capability of developing ideas based on them and inculcate mathematical reasoning.
PSO-7	Will be able to locate and analyse the different mathematical texts with appropriate theoretical framework.
PSO-8	Have the knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in science, social science, engineering and technology.
PSO-9	Should be able to develop analytical skills, critical thinking, creativity, communication and presentation skills through assignments, seminar, project work.
PSO-10	Should be able to apply their skills and knowledge that translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

The four-years undrgraduate programme (honours with research) is divided into Eight Semesters under NEP2020 based on UGC model curriculum. The schemes and syllabus of examination are detailed herewith.

S.N.	Paper	Internal Assessment				Semester Exam		Credit	Hours
		Test	Seminar	Assign.	Total	Min. Passing Marks	Total		
1	DSC	07	06	07	20	40	80	4	60
2	DSE	07	06	07	20	40	80	4	60
3	GE	07	06	07	20	40	80	4	60

Courses and Course Code under UG Programme

(CBCS under NEP – 20)

2023 -2024

Semester	DSC code	Credit	Course Title	DSE Code	Credit	Course Title
First	DSCMAT 01	04	Calculus			
Second	DSCMAT 02	04	Algebra			
Third	DSCMAT 03	04	Calculus and Algebra	DSEMAT 01	04	Discrete Mathematics
Fourth	DSCMAT 04	04	Real Analysis	DSEMAT 02	04	Mechanics
Fifth	DSCMAT 05	04	Linear Algebra	DSEMAT 03	04	Numerical Methods
Sixth	DSCMAT 06	04	Metric Space	DSEMAT 04	04	Probability & Statistics

SEC

Semester	DSC code	Credit	Course Title
I/II/III/IV	SECMAT 01	02	Quantitative Aptitude
I/II/III/IV	SECMAT 02	02	Mathematical & Logical Reasoning

B.Sc. Semester I

DSC-Calculus

Course Outcome

After completing course, students are able to

1. Calculate the limit and examine the continuity and understand the geometrical interpretation of differentiability.
2. Understand the consequences of various mean value theorems.
3. Draw curves in Cartesian and polar coordinate systems.
4. To solve problems related to vector integration.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓	✓	✓
PO_3	✓	✓	✓	✓
PO_4	✓	✓	✓	✓
PO_5			✓	✓
PO_6	✓	✓		
PO_7				
PO_8	✓	✓	✓	✓
PO_9			✓	
PO_{10}	✓	✓		✓
PO_{11}				

B.Sc. (MATHEMATICS)		SEMESTER I	
COURSE TITLE: Calculus			
COURSE CODE: DSCMAT 01		COURSE TYPE: DSC	
Credit -4		Hours-60hrs	
Theory-4	Practical-0	Theory-60	Practical-0
Marks			
Theory-(80+20)		Practical-0	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	Limit , Continuity and Differentiability, Convergence of Sequences and Series of real numbers
Unit II 15 hrs	Successive differentiation, Leibnitz theorem, Maclaurin's &Taylor's series expansions, Rolle's theorem, Lagrange theorem, Cauchy theorem
Unit III 15 hrs	Asymptotes, Curvature, Tracing of curves
Unit IV 15hrs	Introduction about double and triple integration, Line integral ,Surface integral, Volume integral, Problems based on theorems of Gauss , Green ,Stoke's theorems

REFERENCES:

1. Gorakh Prasad: Differential Calculus, Pothishalas Pvt Ltd, Allahabad**.**
2. Khalil Ahmad: Text Book of Calculus, World Edu. Pub., 2012. Int.(P) Ltd. Pub.
3. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus* (10th edition).Wiley India.
4. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer- Verlag.
5. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.

B.Sc. Semester II

DSC-Algebra

Course Outcome

After completing course, students are able to

1. To acquire techniques in solving equations with the help of theory of equations.
2. To understand the concepts of algebra.
3. To be familiar with group theory, ring, integral domain, field and make their fundamental strong.
4. Analyze the consequences of Lagranges theorem.
5. Learn about structure preserving g maps between groups and their consequences.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}					

B.Sc. (MATHEMATICS)		**SEMESTER II**	
COURSE TITLE: Algebra			
COURSE CODE: DSCMAT 02		**COURSE TYPE: DSC**	
Credit -4		**Hours-60hrs**	
Theory-4	**Practical-0**	**Theory-60**	**Practical-0**
Marks			
Theory-(80+20)		**Practical-0**	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	Roots of Polynomial equations, Imaginary Roots, The fundamental theorems of Algebra (without proof), The n^{th} roots of unity, De-Moivre's theorem and its Applications
Unit II 15 hrs	**Groups, Subgroups, Normal Subgroups:** Definition and properties of a group, Abelian groups, Examples of groups, Subgroups and examples, Cosets and their properties, Lagrange's theorem and its applications, Normal subgroups and their properties,
Unit III 15 hrs	**Homorphism, Cyclic and Permutation Groups :** Group homomorphisms and isomorphisms with properties; First, second and third isomorphism theorems for groups,Cyclic groups and properties, Classifications of subgroup of cyclic groups, Permutation group and properties, Even and odd permutations, Cayley's theorem.
Unit IV 15hrs	**Ring, Field and Integral Doman,Ideals:** Definition and properties of a ring, example of rings, Subrings, Integral domain and fields, characteristic of ring and field.Ring Homomorphism,Ideals and Quotient Rings. Field of Quotients of an Integral Domain, Euclidean Rings, Polynomial Rings,

REFERENCES:

1. Gorakh Prasad: Differential Calculus, Pothishalas Pvt Ltd, Allahabad**.**
2. Khalil Ahmad: Text Book of Calculus, World Edu. Pub., 2012. Int.(P) Ltd. Pub.
3. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus* (10th edition).Wiley India.
4. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer- Verlag.
5. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.

B.Sc. Semester III

DSC- III

Course Outcome

Calculus & Algebra

After completing course, Students are able to

1. To understand the concepts of Partial differentiation.

2. To be familiar with group theory, ring, integral domain, field and make their Fundamental strong.

3. Analyze the consequences of Lagrange theorem.

4. Learn about structure preserving g maps between groups and their consequences.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓	✓	
PO_3	✓		✓	✓
PO_4	✓	✓		✓
PO_5				✓
PO_6	✓	✓		
PO_7				
PO_8	✓	✓	✓	
PO_9				
PO_{10}	✓	✓		✓
PO_{11}				

B.Sc. (MATHEMATICS)		SEMESTER III	
COURSE TITLE: Calculus & Algebra			
COURSE CODE: DSCMAT 03		COURSE TYPE: DSC	
Credit -4		Hours-60hrs	
Theory-4	Practical-0	Theory-60	Practical-0
Marks			
Theory-(80+20)		Practical-0	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	**Partial Differetiation**; Continuity of two variable and first order partial derivatives, higher order partial derivatives, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem, Total differentiation and Jacobians.
Unit II 15hrs	**Groups, Subgroups, Normal Subgroups:** Definition and properties of a group, Abelian groups, Examples of groups, Subgroups and examples, Cosets and their properties, Lagrange's theorem and its applications, Normal subgroups and their properties,
Unit III 15 hrs	**Homorphism, Cyclic and Permutation Groups :** Group homomorphisms and isomorphisms with properties; First, second and third isomorphism theorems for groups,Cyclic groups and properties, Classifications of subgroup of cyclic groups, Permutation group and properties, Even and odd permutations, Cayley's theorem.
Unit IV 15hrs	**Ring, Field and Integral Domain,Ideals:** Definition and properties of a ring, example of rings, Subrings, Integral domain and fields, characteristic of ring and field.Ring Homomorphism, Ideals and Quotient Rings. Field of Quotients of an Integral Domain, Euclidean Rings, Polynomial Rings,

Reference:

1. Gorakh Prasad: Integral Calculus, Pothishalas Pvt Ltd, Allahabad.
2. Shanti Narayan: Integral Calculus, S. Chand & Co.
3. Michael Artin(2014). *Algebra*(2nd edition).Pearson.
4. John B. Fraleigh(2007). *A First Course in Abstract Algebra* (7th edition). Pearson.
5. Joseph A. Gallian(2017).*Contemporary Abstract Algebra*(9th edition). Cengage.
6. Kenneth Hoffman & Ray Kunze(2015). *Linear Algebra*(2nd edition). Prentice-Hall.
7. I. N. Herstein(2006).*Topics in Algebra*(2nd edition).Wiley India.
8. Nathan Jacobson(2009).*Basic Algebra* I(2nd edition).Dover Publications.
9. Ramji Lal(2017).*Algebra1:Groups, Rings, Fields and Arithmetic*. Springer.

B.Sc. Semester III
DSE- Discrete Mathematics
Course Outcome

After completing course, students are able to

1. Learn about partially ordered sets, lattices and their types.

2. Understand Boolean Algebra and Boolean Functions, Logic gates ,switching circuit and their application

3. Solve real life problem using finite state machine.

4. Assimilate various graph theoretic concepts and familiarize with their applications.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓		✓	
PO_3	✓		✓	✓
PO_4	✓		✓	✓
PO_5				✓
PO_6	✓	✓		
PO_7				
PO_8	✓	✓	✓	
PO_9				
PO_{10}	✓	✓		✓
PO_{11}	✓	✓		

B.Sc. (MATHEMATICS)		SEMESTER III	
COURSE TITLE: Discrete Mathematics			
COURSE CODE: DSEMAT 01		COURSE TYPE: DSE	
Credit -4		Hours-60hrs	
Theory-4	Practical-0	Theory-60	Practical-0
Marks			
Theory-(80+20)		Practical-0	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	**Sets and propositions:** Cardinality, Mathematical Induction, Principle of Inclusion and Exclusion, and Formal Languages-Ordered Sets , Languages, Phrase, Structures , Grammers ,Types of Grammers and Languages, Permutations, Combinations and Discrete Probability
Unit II 15 hrs	**Relations and Functions:** Partial Order Relations and Lattices, Chains and Anti chains, Pigeon Hole Principle Graphs and Planar Graphs: Basic Terminology, Multigraphs, Weighted Graphs, Paths and circuits, Shortest Paths, Eulerian Paths and circuits, Travelling Salesman Problem, Planar Graphs
Unit III 15 hrs	**Recurrence Relation and Recursive Algorithm:** Linear Recurrence Relations with constant coefficient, Homogenous solutions, Particular solutions, Total Solution, Solution by the method of Generating Function,Discrete Numeric function and Generating Function
Unit IV 15hrs	Boolean Algebra: Lattices and Algebraic structure, Duality, Distributive and complemented Lattices, Boolean Lattices and Boolean Algebras, Boolean Functions and Expressions, Prepositional Calculus, Design and implementation of Digital Networks , Switching Circuits

References

1. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer
Science, McGraw-Hill Book Co., 1997.
2.. C. L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
3. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India
4. K. L. P. Mishra and N. Chandrashekaran, Theory of Computer Science
5. S. Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book
6. Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs

B.Sc. Semester IV

DSC- IV

Course Outcome

Real Analysis

After completing course, Students are able to

1. To understand basic properties of real number system such as least upper bound property and
   Order property.
2. Realize importance of bounded, Convergent, Cauchy and monotonic sequences of real
   numbers, find their limit superior and limit inferior.
3. Understand basic properties of infinite series.
4. Learn about Riemann integrability of bounded functions and algebra of R-integrable
   functions.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4
PO_1	✓	✓	✓	✓
PO_2	✓	✓	✓	✓
PO_3	✓	✓	✓	✓
PO_4	✓	✓	✓	✓
PO_5			✓	✓
PO_6	✓	✓	✓	✓
PO_7			✓	✓
PO_8	✓	✓	✓	✓
PO_9				
PO_{10}	✓	✓	✓	✓
PO_{11}				

B.Sc. (MATHEMATICS)		SEMESTER IV	
COURSE TITLE: Real Analysis			
COURSE CODE: DSCMAT 04		COURSE TYPE: DSC	
Credit -4		Hours-60hrs	
Theory-4	Practical-0	Theory-60	Practical-0
Marks			
Theory-(80+20)		Practical-0	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	**Real Numbers** The set of real numbers R as an ordered field ,Least upper bound properties of R,Metric property and completeness of R,Archemedian Property of R.Dense subsets of R, Nested interval property,Neighbourhood of a point ,Open sets,Limit point of a set , closed sets in R
Unit II 15hrs	**Convergence of sequences in R:**Bounded & monotonic sequences, Convergence sequences and its limit, Limits theorems, Monotonic convergence theorem, Subsequences, Bolzano –Weierstrass theorem, Limit superior and limit inferior, Cauchy sequence , Cauchy's convergence criterion
Unit III 15 hrs	**Infinite Series:** Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criteria for convergence, Test for convergence of positive terms, Comparison test, D'Alembert's ratio test, Cauchy root test, Raabe's test, Logarithm test, Cauchy Integral test, Alternating series, Leibnitz's test
Unit IV 15hs	**Riemann Integral**: Riemann integral. Integrability of continuous and monotonic function.The fundamental theorem of integral calculus. Mean value theorems of integral calculus. **Improper Integral:** Improper integrals and their convergence.Comparison tests,Abel's and Dirichlet's tests.

Reference:

1. R. G. Bartle and D.R. Sherbert, Introduction to Real Analysis 3rd ed, John Wiley and Sons

2. S.C. Malik and Savita Arora: Mathematical Analysis, New Age (P) Ltd. Publishers,

3. Sudhir R Ghorpade and Balmohan V. Limaye, Calculus and Real Analysis, Springer

4. T.M. Apostol: Mathematical Analysis, Addison-Wesley Series in Mathematics,1974.
5. R.R.Goldberg: Real Analysis, Oxford IBH Publishing , New Delhi, 1970.

6.Walter Rudin:Principles of Mathematical Analysis,Tata McGraw Hill.

7.Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs

B.Sc. Semester IV
DSE- Mechanics
Course Outcome

After completing course, students are able to

i) Familiarize with subject matter, which has been the single centre, to which were drawn mathematicians, physicists, astronomers, and engineers together.

ii) 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.

iii) Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight.

iv) Learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions, which were deduced by him long before the mathematical theory given by Newton.

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓			✓

B.Sc. (MATHEMATICS)		SEMESTER IV	
COURSE TITLE: Mechanics			
COURSE CODE: DSEMAT02		**COURSE TYPE: DSE**	
Credit -4		**Hours-60hrs**	
Theory-4	**Practical-0**	**Theory-60**	**Practical-0**
Marks			
Theory-(80+20)		**Practical-0**	

Scheme of Marks:

i. Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.

ii. Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).

iii.Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).

iv. Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).

Unit I 15 hrs	Analytical conditions of Equilibrium, Catenary
Unit II 15 hrs	Forces in three dimensions, Poinsot's central axis, Null lines and Null planes
Unit III 15 hrs	Simple harmonic motion and its geometrical representations, Elastic String, velocities and accelerations along radial and transverse directions, projectile,
Unit IV 15hrs	Motion in resisting medium, Motion of particles in varying mass, Central orbits,Kepler laws of motion,velocity and acceleration in angential and normal directions.

References:

1. R. S. Varma (1962). A Text Book of Statics. Pothishala Pvt. Ltd.
2. P.L. Srivastava (1964). Elementary Dynamics. Ram Narain Lal, Beni Prasad Publishers Allahabad.
3. J. L. Synge & B. A. Griffith (1949). Principles of Mechanics. McGraw-Hill.
4. S.L. Loney (2006). An Elementary Treatise on the Dynamics of a particle and of Rigid Bodies.
5. A. S. Ramsey (2009). Statics. Cambridge University Press.
6. A. S. Ramsey (2009). Dynamics. Cambridge University Press.
7. Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs.

B.Sc. Semester V

DSC- V

Course Outcome

Linear Algebra

After completing course, Students are able to

1. Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix using rank.

2. Find eigen values and corresponding eigen vectors for a square matrix.

3. Understand real vector spaces , subspaces , basis ,dimension and their properties.
4. Learn about properties of linear transformation and isomorphism theorems.
5. Understand the concept of polynomials and their prime factorization.
6. Find canonical form of linear transformation.
7. Obtain various variants of diagonalisation of linear transformations.
8. Apply Cauchy-Schwarz inequality for deriving metric on inner product spaces and obtain orthonormal basis using Gram-Schmidt orthogonalisation.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5			
PO_1	✓	✓	✓	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓	✓	✓	✓
PO_3	✓	✓	✓	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓	✓	✓	✓
PO_5				✓				
PO_6	✓	✓				✓	✓	✓
PO_7					✓			
PO_8	✓	✓	✓			✓	✓	✓
PO_9			✓					
PO_{10}	✓	✓		✓		✓	✓	✓
PO_{11}				✓	✓			

B.Sc. (MATHEMATICS)		SEMESTER V	
COURSE TITLE: Linear Algebra			
COURSE CODE: DSCMAT 05		COURSE TYPE: DSC	
Credit -4		Hours-60hrs	
Theory-4	Practical-0	Theory-60	Practical-0
Marks			
Theory-(80+20)		Practical-0	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	**Row Echelon form of Matrices and Applications:** Systems of linear equations, Row reduction and echelon forms ,The rank of Matrices & its application in solving system of linear equations, Symmetric and Skew- symmetric , Self adjoint, orthogonal, Hamilton, Skew- Hamilton and Unitary matrices , the inverse of square matrix, Eigen value and Eigen vectors , The Characteristic equation, The Caley- Hamilton Theorem
Unit II 15hrs	**Vector Spaces:** Definition and examples 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. Existence of complementary subspace ofa subspace of a finite dimensional vector space. Dimension of sums of subspaces.Quotient space and its dimension
Unit II **15 hrs**	**Linear transformations, Eigen values and eigen vectors, Bilinear, Quadratic and Hermitian forms.** Linear transformations and their representation as matrices. The Algebra of linear transformations. The rank nullity theorem. Change of basis. Dual space. Bidual space and natural isomorphism. Adjoint of a linear transformation. Eigen values and eigen vectors of a linear transformation.Diagonalisation. Bilinear, Quadratic and Hermitian forms.
Unit IV 15hrs	**Inner Product Spaces:** Inner Product Spaces**,**Cauchy Schwarz inequality.Orthogonal complements. Orthogonal sets and bases. Bessel's inequality for finite dimensional spaces. Gram-Schmidt Orthogonalization process.

Reference:

1.I.M. Gel'fand(1989),Lectures on Linear Agebra.Dover Publications

2.Kenneth Hoffman & Ray Kunze(2015).Linear Algebra,Prentice Hall.

3.Nathan Jacobson(2009),Basic Algebra I, Dover Publications.

4. Nathan Jacobson(2009),Basic Algebra II, Dover Publications.

5.Gilbert Strang(2014).Linear Algebra and its Applications.Elsevier

6. Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs

B.Sc. (MATHEMATICS)
SEMESTER V

DSE- Numerical Methods

Course Outcome

After completing course, students are able to

1. Obtain numerical solutions of algebraic and transcendental equations.
2. Find numerical solutions of system of linear equations and to check the Accuracy of the solutions.
3. Learn about various interpolating and extrapolating methods to find numericalsolutions.
4. Solve initial and boundary value problems in differential equations using numericalmethods.
5. Apply various numerical methods in real life problems.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9	✓		✓		✓
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓			✓

B.Sc. (MATHEMATICS)		SEMESTER V	
COURSE TITLE: Numerical Methods			
COURSE CODE: DSEMAT03		COURSE TYPE: DSE	
Credit -4		Hours-60hrs	
Theory-4	Practical-0	Theory-60	Practical-0
Marks			
Theory-(80+20)		Practical-0	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted**.

ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**

iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**

iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	**Numerical Methods for Solving Algebraic and Transcendental Equations –** Round-off error and computer arithmetic, Local and global truncation errors, Algorithms andconvergence; Bisection method, false position method, fixed point iteration method, Newton's method and secant method for solving equations.
Unit II 15 hrs	**Numerical Methods for Solving Linear Systems-** LU decomposition and its applications, Thomas method for tridiagonal systems; Gauss Jacobi, Gauss Seidel and successive over-relaxation (SOR)methods.
Unit III 15 hrs	**Interpolation-** Lagrange and Newton interpolations, Piecewise linear interpolation, Cubic splineinterpolation, Finite difference operators, Gregory Newton forward and backward differenceinterpolations**.**
Unit IV 15hrs	**Numerical Differentiation and Integration-**First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rule and its error analysis,

References:

1. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson.

2. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition),Pearson Education, India.

3. M.K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientificand Engineering Computation (6th edition). New Age International Publishers.

4. Robert J. Schilling & Sandra L. Harris (1999). Applied Numerical Methods forEngineers Using MATLAB and C. Thomson-Brooks/Cole.

5. Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs.

B.Sc. Semester VI

DSC- VI

Course Outcome

Metric Spaces

After completing course, Students are able to

1. Understand the concept of metric ,distance, convergence, completeness, compactness, connected.
2. Apply these concepts to key classess of spaces.
3. Learn to analyze mapping between spaces.
4. Learn to use metric space methods to solve problems of science and engineering.
5. Attain background for advanced courses in real analysis, functional analysis and topology.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5				✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9			✓		
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓			✓

B.Sc. (MATHEMATICS)		SEMESTER VI	
COURSE TITLE: Metric Spaces			
COURSE CODE: DSCMAT 06		**COURSE TYPE: DSC**	
Credit -4		**Hours-60hrs**	
Theory-4	**Practical-0**	**Theory-60**	**Practical-0**
Marks			
Theory-(80+20)		**Practical-0**	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.**
ii. **Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	**Introductory Concepts:** Definition and examples of metric spaces. Neighbourhoods, Limit points, Interior points, Open and closed sets. Closure and interior. Boundary points. Sub-space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. Contraction principle.
Unit II 15hrs	Cantor's intersection theorem. Contraction principle. Dense subsets and seperable spaces, No- where dense subsets, Baire's Category theorem. First countable and second countable space. Continuous functions. Equivalent metrics, .Extension theorem, Uniform continuity
Unit III 15 hrs	Compactness. Sequential compactness. Totally bounded space. Finite intersection property., Equivalence of Compactness and sequential Compactness ,Finite intersection property, Continuous functions and compact sets.
Unit IV	Seperated sets, Disconnected and connected sets, Components, Connected subset of R,, Continuous functions and connected sets.

Reference:

1. Metric Spaces,P.K.Jain and Khalil Ahmad,New Age International, New Delhi.
2. An Introduction to Metric Space, D Gopal, A. Deshmukh, A,S, Randive and S.Yadav, CRC Press, London.
3. Mathematical Analysis II –Metric Spaces, J.N.Sharma , Krishna Prakashan.
4. Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs.

B.Sc. Semester VI
DSE- Probability & Statistics
Course Outcome

After completing course, students are able to

i) Understand the basic concepts of probability.

ii) Appreciate the importance of probability distribution of random variables and toknow the notion of central tendency.

iii) Establish the joint distribution of two random variables in terms their relation and regression.

iv) Understand central limit theorem which shows that the empirical frequencies of somany natural populations exhibit normal distribution.

v) Study entropy and information theory in the framework of probabilistic models.

PO-CO Mapping

	CO_1	CO_2	CO_3	CO_4	CO_5
PO_1	✓	✓	✓	✓	✓
PO_2	✓	✓	✓		✓
PO_3	✓	✓	✓	✓	✓
PO_4	✓	✓	✓	✓	✓
PO_5	✓	✓	✓	✓	
PO_6	✓	✓			
PO_7					✓
PO_8	✓	✓	✓		
PO_9	✓		✓		✓
PO_{10}	✓	✓		✓	
PO_{11}	✓	✓			✓

B.Sc. (MATHEMATICS)		SEMESTER VI	
COURSE TITLE: Probability & Statistics			
COURSE CODE: DSEMAT04		**COURSE TYPE: DSE**	
Credit -4		**Hours-60hrs**	
Theory-4	**Practical-0**	**Theory-60**	**Practical-0**
Marks			
Theory-(80+20)		**Practical-0**	

Scheme of Marks:

i. Objective type questions: Ten questions carrying 1 marks each to be asked 08 to be attempted.

ii. Short answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 100 words).

iii. Middle answer type questions: Five questions carrying 7 marks each to be set three to be attempted (Word limit 250 words).

iv. Long answer type questions: Three questions carrying 13 marks each to be set three to be attempted (Word limit 750 words).

Unit I 15 hrs	**Probability And Random Variables-**Axiomatic and empirical definitions of probability, Independent and dependent events, Conditional probability and Baye's theorem; Discrete and continuous random variables andtheir probability distributions, Cumulative distribution function, n^{th} Moments, Moment generating function, Characteristic function
Unit II 15 hrs	**Univariate Distributions** Discrete distributions**:** Bernoulli trials and Bernoulli distribution, Binomial and Poisson distributions; Continuous distributions**:** Uniform, Geometric, Gamma, Exponential, Chi- square, Beta and normal distributions; Normal approximation to the binomial distribution,
Unit III 15 hrs	**Bivariate Distribution-**Joint cumulative distribution function and its properties, Join ability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations, Independence of bivariate random variables.
Unit IV 15hrs	**Correlation and Regression**The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Linear regression for two variables, The method of least square

References:

1.David Applebaum (1996). *Probability and Information: An Integrated Approach.*Cambridge University Press.

2.Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). *Introduction to Mathematical Statistics* (7th edition), Pearson Education.

3.Irwin Miller & Marylees Miller (2014). *John E. Freund's Mathematical*

Statisticswith Applications (8th edition). Pearson. Dorling Kindersley Pvt. Ltd.

India.6. Suggested Equivalent online courses: Web link NPTEL/SWAYAM /MOOCs.

B.Sc. /B.A. / B.Com. / B.C.A.			**SEMESTER I/II/III/IV**
COURSE TITLE: Quantitative Aptitude			
COURSE CODE:SECMAT –001			**COURSE TYPE: SEC**
Credit -2		**Hours-30hrs**	
Theory-2	**Practical-0**	**Theory-30**	**Practical-0**
Marks			
Theory-(40+10)		**Practical-0**	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 07 to be attempted.**
ii. **Short answer type questions: Five questions carrying 2 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 5 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	Alphabet, Coding & Decoding, Direction & Distance, Ranking & Comparison of Rank
Unit II 15 hrs	Calendar, Time & Clocks, Arithmetical Reasoning , Blood Relation

REFERENCES:

1. Dr. R. S. Agrawal , A Modern Approach to Verbal & Non-verbal Reasoning, S.Chand Publication.
2. BS Sijwali & Indu Sijwali , A New Approach to Reasoning – Verbal, Non-verbal & Analytical Arihant Publication.
3. K.Kundan, Advanced Verbal Reasoning, Magical Book Series
4. Dhiraj Ku. Singh, Verbal Reasoning, Lucent Publication

B.Sc. /B.A. / B.Com. / B.C.A.			**SEMESTER I/II/III/IV**
COURSE TITLE: Logical and Mathematical Reasoning			
COURSE CODE:SECMAT –002			**COURSE TYPE: SEC**
Credit -2		**Hours-30hrs**	
Theory-2	**Practical-0**	**Theory-30**	**Practical-0**
Marks			
Theory-(40+10)		**Practical-0**	

Scheme of Marks:

i. **Objective type questions: Ten questions carrying 1 marks each to be asked 07 to be attempted.**
ii. **Short answer type questions: Five questions carrying 2 marks each to be set three to be attempted (Word limit 100 words).**
iii. **Middle answer type questions: Five questions carrying 4 marks each to be set three to be attempted (Word limit 250 words).**
iv. **Long answer type questions: Three questions carrying 5 marks each to be set three to be attempted (Word limit 750 words).**

Unit I 15 hrs	Alphabet, Coding & Decoding, Direction & Distance, Ranking & Comparison of Rank
Unit II 15 hrs	Calendar, Time & Clocks, Arithmetical Reasoning , Blood Relation

REFERENCES:

1. Dr. R. S. Agrawal , A Modern Approach to Verbal & Non-verbal Reasoning, S.Chand Publication.
2. BS Sijwali & Indu Sijwali , A New Approach to Reasoning – Verbal, Non-verbal & Analytical
   Arihant Publication.
3. K.Kundan, Advanced Verbal Reasoning, Magical Book Series
4. Dhiraj Ku. Singh, Verbal Reasoning, Lucent Publication