RAJ RISHI GOVT. (AUTONOMOUS) COLLEGE, ALWAR (RAJ.)

(An Autonomous Institute Affiliated to RRBMU,Alwar)

THREE/FOUR YEAR UNDERGRADUATE PROGRAMME

FACULTY OF SCIENCE

Programme : Bachelor of Science (Mathematics)

Programme Code: UG0105 Bachelor of Science (Mathematics)

Subject/Course/Discipline-Mathematics

Medium of Instruction : Hindi / English

(Syllabus as per NEP-2020 and Choice Based Credit System)

(Academic Year 2023-24 Onwards)

Name of College	Raj Rishi Govt. (Autonomous) College Alwar (Rajasthan)
Name of Faculty	Science
Name of Programme	Three/Four Year Bachelor of Science (Mathematics)
Name of Discipline	Mathematics

SEMESTER - WISE PAPER TITLES WITH DETAILS

Three/Four Year Bachelor of Science (Mathematics)										
				Mathematics	Credits					
S. No.	Level	Semester	Type	Programme Code	Course Code	Title	L	T	P	Total
1.	5	I	MJR	UG0105	MAT-51T-101	Discrete Mathematics &Optimization Techniques.	6	0	0	6
2.	5	I	MJR	UG0105	MAT-51T-102	Number theory	6	0	0	6
3.	5	II	MJR	UG0105	MAT-52T-103	Calculus	6	0	0	6
4.	5	II	MJR	UG0105	MAT-52T-104	Operations Research	6	0	0	6

RAJ RISHI GOVT. (AUTONOMOUS) COLLEGE,

ALWAR (Raj.)

SYLLABUS

(Three/Four Year under Graduate Programme in Science)

I & II Semester

Examination-2023-24

As per NEP - 2020

SYLLABUS

SCHEME OF EXAMINATION AND COURSE OF STUDY

UNDER NEP 2020

For

(SEMESTER SCHEME: I & II Semester)

FACULTY OF SCIENCE

UG0105-Three/Four Year Bachelor of Science (MATHEMATICS)

Medium of Instruction: Hindi and English

EXAMINATION 2023-2024 AND ONWARDS

27.9.2023

PROGRAMME PREREQUISITES
Mathematics course of XIIth std. of Central Board of Secondary Education or equivalent.
PROGRAMME OUTCOMES (PO)
The program would enable students to take on advanced courses in Mathematics with global needs and to serve as a formidable skill-force in research, academia, industry, government, and other sectors where Mathematics is reckoned as a strong devising and design tool with diverse interdisciplinary applications.

Syllabus: UG0105-Three/Four Year Bachelor of Science (MATHEMATICS)

I-Semester-Mathematics
(2023-2024 & onwards)

Type	Paper code and Theory Nomenclature	Duration of Examination	Maximum Marks (CA+ EOSE)	Minimum Passing Marks (CA + EOSE)
Theory	UG0105-MAT-51T-101-Discrete Mathematics & Optimization Techniques	1 Hrs-CA 3 Hrs-EOSE	30 Marks-CA 120 Marks-EOSE	12 Marks-CA 48 Marks-EOSE
Theory	UG0105-MAT-51T-102-Number Theory	1 Hrs-CA 3 Hrs-EOSE	30 Marks-CA 120 Marks-EOSE	12 Marks-CA 48 Marks-EOSE

Semester	**Code of the Course**	**Title of the Course/Paper**	**NHEQF Level**	**Credits**
I	UG0105-MAT-51T- 101	Discrete Mathematics & Optimization Techniques	5	6
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture, Ninety Lectures		
Prerequisites	Mathematics course of XII std. of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The objective of the course is to expose discrete structures and involved topology, an optimization of real world problems.			

27.9.2023

Syllabus

UG0105-MAT-51T-101-Discrete Mathematics & Optimization Techniques

Teaching: 6 Hours per Week **Duration of Examination: 3 Hours**

Maximum Marks (CA + EoSE): 30 Marks-CA and 120 Marks -EoSE

Minimum Passing Marks (CA + EOSE): 12 Marks - CA and 48 Marks-EOSE

The Question Paper will be divided into two parts, Part-A and Part-B. Part-A: Part-A contains one compulsory question consisting of 8 short answer type questions, each carrying 3 marks. These 8 short answer questions are selected from all the units, with two questions from each unit. The Part-A of the question paper evaluates the candidate's knowledge, understanding, and application of the topics/texts covered in the syllabus.

Part-B: Part-B comprises four questions with one question from each unit, each carrying 24 marks. Each question in Part-B has four subparts. The candidate must attempt all four units by selecting any two subparts from each question. Each subpart within a question carries equal marks.

Note: The question Paper will be set in both Hindi and English.

Unit-I

Relations on a set, Equivalence class, partial order relations, Chains and Anti-chains. Lattices, Distributive and Complemented Lattices, Boolean algebra, conjunctive normal form, disjunctive normal form, Pigeon hole principle. Principle of inclusion and exclusion. Propositional calculus, Basic logical operations, Truth tables, Tautologies and contradictions

Unit -II

Discrete numeric functions, Generating functions, Recurrence relations, linear recurrence relation with constant coefficients and their solutions, Total solutions, Solution by the method of generating functions. Basic concepts of graph theory, Types of graphs, Planar graphs, Walks, Paths & Circuits, Shortest path problem.

Unit -III

Planar graphs, Operations on graphs (union, join, products). Matrix representation of graphs, Adjacency matrices, Incidence matrices. Hamiltonian and Eulerian graphs. Tree, Spanning tree, Minimum spanning tree, Distance between vertices, Center of tree, Binary tree, Rooted tree.

Unit-IV

Linear programming problems. Basic solution. Some basic properties and theorems on convex sets. Simplex algorithm, Two-phase method. Duality. Solution of dual problems. Transportation problems. Assignment problems.

Suggested Books and References -

1. V.K.Balakrishnan, Introductory Discrete Mathematics, Prentice-Hall, 1996.
2. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
3. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
4. Kenneth H. Roson, Discrete Mathematics and Its Applications, Tata Mc-Graw Hills, New Delhi, 2003.
5. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
6. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Course Learning Outcomes:

The course would enable the student

1. To understand the ideas in discrete structures viz. Partially ordered sets, Lattices, Graphs etc. and allied conceptual intricacies with applications.
2. To understand mathematical formulation of optimization problems and allied theoretical concepts for solution methodologies.

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
I	UG0105-MAT-51T- 102	Number Theory	5	6
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture, Ninety Lectures		
Prerequisites	Mathematics course of XII std. of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The objective of the Course is to provide students with a comprehensive understanding of Euclidean algorithm Congruence and Cryptography			

Syllabus

UG0105-MAT-51T-102-Number Theory

Teaching: 6 Hours per Week **Duration of Examination: 3 Hours**

Maximum Marks (CA+ EOSE): 30 Marks-MT and 120 Marks - EOSE

Minimum Passing Marks (CA + EoSE): 12 Marks - CA and 48 Marks - EoSE

The Question Paper will be divided into two parts, Part-A and Part-B. Part-A: Part-A contains one compulsory question consisting of 8 short answer type questions, each carrying 3 marks. These 8 short answer questions are selected from all the units, with two questions from each unit. The Part-A of the question paper evaluates the candidate's knowledge, understanding, and application of the topics/texts covered in the syllabus.

Part-B: Part-B comprises four questions with one question from each unit, each carrying 24 marks. Each question in Part-B has four subparts. The candidate must attempt all four units by selecting any two subparts from each question. Each subpart within a question carries equal marks.

Note: The question Paper will be set in both Hindi and English.

Unit-I

Divisibility - Division Algorithm, Divisibility in Z, g.c.d., the Euclidean algorithm, l.c.m., Primes, Infinitude of primes, Fundamental theorem of Arithmetic, Fibonacci sequence, Fibonacci numbers and their properties. Congruence - Linear congruence, Chinese Remainder theorem.

Unit -II

Fermat's Little theorem, Wilson's theorem, Fermat's factorization, Euler's factorization, Mersenne's factorization. Number theoretic functions: tau and sigma-functions, the Mobius function and inversion formula, Greatest integer function, Euler's phi function, Euler's generalization of Fermat's theorem and the properties of phi function.

Unit -III

Application to Cryptography, Diophantine equations: - $ax + by = c$, $ax + by + cz = d$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^2$, $x^4 + y^4 = z^4$,, $x^4 - y^4 = z^2$, Fermat's last theorem, General Integer solution of the equation $x^2 + y^2 + z^2 = w^2$; (x,y,z,w) = 1.

Unit-IV

Quadratic congruence, Quadratic residues, Legendre symbol and its properties, Quadratic reciprocity, Order of an integer and its properties, Primitive roots for primes, Composite numbers having primitive roots, Theory of indices

Suggested Books and References:-

1. S.Telang and M. Nadkarni, Number Theory, Tata McGraw-Hill, 2001.
2. David M. Burton, Elementary Number Theory (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.
3. I. Niven and H. Zukerman, An Introduction to the theory of Numbers, Wiley Eastern University Edition, New Delhi, 1985.
4. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007

Course Learning Outcomes:

The course would enable the student

1. To apply Euclid's algorithm and Chinese Remainder Theorem.
2. To understand the definitions of congruencies, residue classes and Application to Cryptography.
3. To apply number theoretic functions in various branches of mathematics.

Syllabus: UG0105-Three/Four Year Bachelor of Science (Mathematics)

II-Semester-Mathematics

(2023-2024 & onwards)

Type	Paper code and Theory Nomenclature	Duration of Examination	Maximum Marks (CA+ EOSE)	Minimum Passing Marks (CA + EOSE)
Theory	UG0105-MAT-52T-103-Calculus	1 Hrs-CA 3 Hrs-EOSE	30 Marks-CA 120 Marks-EOSE	12 Marks-CA 48 Marks-EOSE
Theory	UG0105-MAT-52T-104-Operation Research	1 Hrs-CA 3 Hrs-EOSE	30 Marks-CA 120 Marks-EOSE	12 Marks-CA 48 Marks-EOSE

Semester	**Code of the Course**	**Title of the Course/Paper**	**NHEQF Level**	**Credits**
II	UG0105-MAT-52T- 103	CALCULUS	5	6
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture, Ninety lectures		
Prerequisites	Mathematics course of XII std. of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The objective of the course is to provide students with a comprehensive understanding of the fundamental concepts of calculus as a tool for dynamic systems.			

Syllabus

UG0105-MAT-52T-103-Calculus

Teaching: 6 Hours per Week **Duration of Examination: 3 Hours**

Maximum Marks (CA + EoSE): 30 Marks - CA and 120 Marks - EoSE
Minimum Passing Marks (CA + EOSE): 12 Marks - CA and 48 Marks - EOSE

The Question Paper will be divided into two parts, Part-A and Part-B. Part-A: Part-A contains one compulsory question consisting of 8 short answer type questions, each carrying 3 marks. These 8 short answer questions are selected from all the units, with two questions from each unit. The Part-A of the question paper evaluates the candidate's knowledge, understanding, and application of the topics/texts covered in the syllabus.

Part-B: Part-B comprises four questions with one question from each unit, each carrying 24 marks. Each question in Part-B has four subparts. The candidate must attempt all four units by selecting any two subparts from each question. Each subpart within a question carries equal marks.

Note: The question Paper will be set in both Hindi and English.

Unit I

Taylor's theorem, Maclaurin's theorem, Power series expansion of a function, Power series expansion of $\sin x, \cos x, e^x, \log_e(1+x), (1+x)^n$, Derivative of the length of an arc. Pedal equations Curvature: Various formulae, Centre of curvature and chord of curvature. Partial differentiation, Euler's theorem for homogeneous functions, Chain rule of partial differentiation, Total differentiation, Differentiation of implicit functions,

Unit II

Envelopes: One parameter family of curves when two parameters are connected by a relation. Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers, Asymptotes: Definition, Parallel to coordinate axes, General rational algebraic curves, inspection method, Intersection of a curve and its asymptotes. Multiple points, Curve tracing of standard curves (Cartesian and Polar curves).

Unit III

Beta and Gamma functions, Reduction formulae (simple standard formulae), Double integrals in Cartesian and Polar Coordinates, Change of order of integration, Triple integrals. Dirichlet's integral. Rectification, Area, Volume and Surface of solids of revolution

Unit IV

Scalar and Vector point functions. Differentiation of vector point functions Directional derivative. Differential operators, Gradient, Divergence and Curl, Integration of vector point functions. Line, Surface and Volume integral, Theorems of Gauss, Green, Stokes (without proof) and problems based on these theorems.

Suggested Books and References -

1. Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand & Co., N. D., 2013.
2. H.S. Dhami, Differential Calculus, Age Int. Ltd., New Delhi, 2012.
3. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
4. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002.
5. G.B. Thomas, R. L. Finney, M. D. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand the concept of curvature and pedal equations.
2. Understand the concept of maxima-minima, double triple integration and its applications.
3. Understand the concept of vector calculus viz. operators, vector integration.

Semester	**Code of the Course**	**Title of the Course/Paper**	**NHEQF Level**	**Credits**
II	UG0105-MAT-52T- 104	Operations Research	5	6
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture, Ninety Lectures		
Prerequisites	Mathematics course of XII std. of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The objective of the course is to enable students learn concepts in optimization techniques viz. game theory, Inventory models, job sequencing and queueing			

27.9.2023

Syllabus

UG0105-MAT-52T-104-Operations Research

Teaching: 6 Hours per Week **Duration of Examination: 3 Hours**

Maximum Marks (CA + EoSE): 30 Marks-CA and 120 Marks-EOSE
Minimum Passing Marks (CA + EOSE): 12 Marks-CA and 48 Marks-EOSE

The Question Paper will be divided into two parts, Part-A and Part-B. Part-A: Part-A contains one compulsory question consisting of 8 short answer type questions, each carrying 3 marks. These 8 short answer questions are selected from all the units, with two questions from each unit. The Part-A of the question paper evaluates the candidate's knowledge, understanding, and application of the topics/texts covered in the syllabus.

Part-B: Part-B comprises four questions with one question from each unit, each carrying 24 marks. Each question in Part-B has four subparts. The candidate must attempt all four units by selecting any two subparts from each question. Each subpart within a question carries equal marks.

Note: The question Paper will be set in both Hindi and English.

Unit I

Inventory Models - Definitions, Types of inventory models, costs involved in inventory models, Classification of inventory models. Static demand models in Inventory control: EOQ models without shortage, EOQ models with shortage, limitations of EOQ formula, EOQ model with finite replenishment rate. Several items inventory models with constraints: EOQ model with floor space constraint, EOQ model with average inventory level constraint, EOQ model with investment constraint. EOQ models with quantity discounts:

Unit II

Theory of Games - Introduction, Basic definitions, Minimax (Maximin) criterion and Optimal strategy. Solution of game with saddle point. Minimax-Maximin principle for mixed strategy games, Fundamental theorem of Game theory. Solution of 2X2 mixed strategy game. Solution of 2X2 mixed strategy game by the method of oddments. Dominance principle. Solution game by matrix method. Graphical method for solving 2Xn or mX2 game, Linear programming method for the solution of game, Solution of 3X3 games with mixed strategy by the method of oddments, Iterative method for approximate solution of a game.

Unit III

Queueing Theory - Introduction, classification of queuing models. Distribution of arrivals. Distribution of inter-arrival time, Distribution of departures, Distribution of service time. Solution of queuing models: Model 1 (M/M/1): (∞/FCFS), Model 2 (M/M/1): (N/FCFS), Model 3 (M/M/C): (∞/FCFS), Model 4 (M/M/1): (N/FCFS), Model 5 (M/M/1): (R/GD) single server and finite source of arrivals, Model 6 (M/M/C): (R/GD) multi server and finite input source.

Unit IV

Sequencing Models: Sequencing problems, processing n jobs through two machines. Processing n jobs through three machines, processing two jobs through m machines and processing n jobs through shortest cyclic Route Models. Minimal path problem (shortest Acyclic Route Models). Replacement models: introduction, Failure of items, Replacement of items that deteriorate, Replacement of items with increasing running costs, Replacement of items that fail completely, Group replacement policy, Recruitment and promotional problems, Equipment renewal problem.

Suggested Books and References –

1. 1. J.K. Sharma, Operation research- Theory and Application, Macmillan Pub. India Ltd. KantiSwaroop, P. K.Gupta and Man mohan, Operation Research, Sultan Chand & . Chand & Co., N.D., 2007.
2. S.D.Sharma, Operations Research, Kedar Nath, Ram Nath and co. Meerut, 2005.
3. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research Concepts and Cases (9th Edition), Tata McGraw Hill, 2010.
4. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Analyse inventory models, costs, and constraints for efficient management.
2. Apply game theory principles to strategize and optimize outcomes.
3. Understand queuing theory and solve queuing models for various scenarios.
4. Master sequencing models for optimal task scheduling and job processing.
5. Apply replacement models for effective resource management and decision-making.