Gujarat University

Choice Based Credit System (CBCS)

Syllabus for B. Sc. Semester VI (Mathematics)

MAT 307: Abstract Algebra-II (Theory)

Hour/week: 4 **Credits:** 4

Unit I:

Rings: Definition and examples, commutative ring, division ring, unity and unit elements of a ring, Field, properties of a ring, Boolean ring, Finite rings.

Integral Domain: Zero divisor, Definition and examples of Integral Domain (Finite and of infinite order), Characteristic of a ring

Unit II:

Subrings: Definition and examples, necessary and sufficient criterion for subring, Ideals: Definition and examples, necessary and sufficient criterion for ideal, principal ideal ring, quotient ring and its operation tables

Homomorphism: Definition and some examples, Kernel of homomorphism, Isomorphism of rings, Fundamental theorem on homomorphism, homomorphism and characteristic.

Unit III:

Polynomial ring: Introduction and definition of polynomial, degree of polynomial, operation between polynomials, Integral domain D[x], different types of polynomials, factorization of polynomials, Division algorithm for polynomials, irreducibility of polynomial over field, Remainder and factor theorem, solution of polynomial equation, zero of polynomial, Eisenstein's criterion for irreducibility, rational zero of polynomial.

Unit IV:

Fields: Fields, Subfields, Extension field, The field of quotients and integral domain, Prime fields, Finite fields, Maximal ideals, Prime ideals and their characterization through quotient ring.

Text Book:

Abstract Algebra - I. H. Sheth, Prentice-Hall of India Pvt. Ltd. New Delhi, Second edition -2003

Reference Books:

1. Abstract Algebra Theory and Applications -Thomas W. Judson, Stephen F. Austin State University, 2009.
2. Basic Abstract Algebra - Bhattacharya P.B., Jain S. K. and Nagpal S. R., Foundation Books, New Delhi.
3. A First Course in Abstract Algebra - Fraleigh J.B., Narosa Publishing, New Delhi.
4. Topics in Algebra – I. N. Herstein, Vikas Publishing, New Delhi.
5. Algebra - Michael Artin, PHI.
6. A survey of Modern Algebra - G.Birkhoff & S. Maclane, Uni. Press.
7. A first course in Abstract Algebra (Rings, Groups & fields) - Marlow Anderson & Todd Fel, Chrpman & Halilereivy.
8. Proofs from the Book - Aigner

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Gujarat University
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
MAT 308: Analysis-II (Theory)

Hours: 4 /week **Credits: 4**

Unit I: Riemann Integration

1.1. Definition of the integral
1.2. Properties of the integral
1.3. Existence theory (monotone, continuous functions etc. (includes Riemann sums)
1.4. Fundamental theorem
1.5. Integration by parts and change of variable
1.6. Mean value theorems (Weierstrass's Form and Bonnet's Form)

Articles 5.1 to 5.5 of (I); 1.5 and 1.6 to be supplemented from reference books

Unit II: Infinite series

2.1 Basic Theory (covers upto comparison test)
2.2 Series with positive terms (Condensation Test, Pringsheim's Test)
2.3 Absolute convergence (includes alternating series), ratio and root tests with lim sup and lim inf

Articles 6.1, and 6.2 of (I); 2.2 to be supplemented from reference books.

Unit III: Infinite Series –II

3.1 Rearrangement of series, Cauchy Product of Series, Merten's theorem
3.2 Power Series
3.3 Improper integrals of the first and second kind.

3.1 to be supplemented from reference books; others from Articles 6.3 and 5.5 of (I)

Unit IV: Taylor Series

4.1 Taylor's Theorem with Lagrange and Cauchy form of remainders
4.2 Expansions of exponential ,logarithmic and trigonometric functions
4.3 Binomial series theorem
4.4 Power series solutions of differential equations

Articles 6.4 and 8.3 of (I); 4.2 and 4.3 to be supplemented from reference books

Text Book:

(I) An Introduction to Analysis, Gerald G.Bilodeau, Paul R.Thie and G.E.Keough. Jones and Bartlett Student edition

Reference Books:

1. Fundamentals of Mathematical Analysis, Das and Pattanayak, TMH.
2. Calculus Vol 1, Tom M. Apostol.
3. Principles of Mathematical Analysis, W. Rudin, McGraw-Hill
4. Mathematical Analysis by Tom M. Apostol, Narosa Publ. House India.

5. Calculus, Michael Spivak.
6. Understanding Analysis - Stephen D. Abbott.
7. A Course in Calculus & Real Analysis - S. R. Ghorpade & B. V. Limaye.
8. Elementary Analysis: the theory of calculus - K. Ross, Springer, India.
9. Numbers to Analysis - I. K. Rana, world scientific.
10. Mathematical Analysis- Andrew Browder, Springer ISBN No. 978-81-8489-520-9.
11. A First course in Aanalysis- D. Somasundaram & B. Choudhary

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Gujarat University
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
MAT 309: Analysis-III (Theory)

Hours: 4 /week **Credits: 4**

Unit I: Metric Spaces
- 1.1. Definition and Examples.
- 1.2. Open Sets.
- 1.3. Closed Sets
- 1.4. Convergence, Completeness and Baire's Theorem

Articles 9, 10, 11 and 12 of Text Book (1)

Unit II: Continuity, Compactness and Connectedness
- 2.1 Continuous mappings

Unit III: Uniform Convergence
- 3.1 Pointwise Convergence
- 3.2 Uniform Convergence
- 3.3 Uniform Convergence and Continuity
- 3.4 Uniform Convergence and Differentiation
- 3.5 Term by Term Integration of Series
- 3.6 Term by Term Differentiation of Series

Articles 9.1-9.5 of Text Book (2)

Unit IV: Applications of Uniform Convergence
- 4.1 Power Series (advanced)
- 4.2 Abel's Limit Theorem, Multiplication of Power Series
- 4.3 Taylor's Series
- 4.4 Weierstrass's Approximation Theorem
- 4.5 Exponential, Logarithmic and Trigonometric Functions

Articles 9.6-9.8 of Text Book (2), 4.5 from section 8.3 and 8.4 of Text Book (3)

Text Books:

1. Topology and Modern Analysis - G. F. Simmons.
2. Fundamentals of Mathematical Analysis - Das and Pattanayak, TMH.
3. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition, 2010.

Reference Books:

1. A .Course in Calculus & Real Analysis - S. R. Ghorpade & B. V. Limaye
2. Elementary Analysis: the theory of calculus - K. Ross, Springer.India.
3. Numbers to Analysis - I. K. Rana, world scientific.
4. Metric Spaces - Shirali, Springer, India.
5. Topology of Metric Spaces - S. Kumaresan, Narosa
6. An Introduction to Analysis - Arlen Brown & Carl Pearcy, Springer, India.
7. Analysis I By Herbert Amann & Joa Chim Escher, Birkhauser Verlag, Berlin.
8. Topology By B. D. Gupta, Kedarnath Ram Nath, Delhi.
9. Mathematical Analysis: Linear & Metric Structure & Continuity - Mariano Giaquinta & Giuseppe Modica Birkhauser, Boston.
10. Mathematical Analysis- Andrew Browder, Springer ISBN No. 978-81-8489-520-9.

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Gujarat University
Choice Based Credit System(CBCS)
Syllabus for B. Sc. Semester VI (MATHEMATICS)
MAT-310: Graph Theory(Theory)

Hours: 4/Week **Credits: 4**

Unit I:

Graph, Graphs as Models, More Definitions, Vertex Degrees, Subgraphs, Path and Cycles.

Unit II:

The Matrix Representation of Graphs, Fusion, Definition and simple properties, Bridges.

Unit III:

Spanning Trees, Connector problems (Omit the proofs of theorems 2.14-2.18), Shortest path Problems, Cut vertices and Connectivity.

Unit IV:

Euler Tours, (Omit the proof of Theorem 3.5), Hamiltonian Graphs.

Text Book:

A First Look at Graph Theory - John Clark and Derek Allan Holton, Allied Publishers Limited, Chapters 1 to 3 (Omit 3.2 and 3.4).

Reference Books:

1. Introduction to Graph Theory - R. J. Wilson, Longman.
2. Introduction to Graph Theory - Douglas B. West, Prentice-Hall of India, Second Edition, 2006, ISBN-81-203-2142-1.
3. Invitation to Graph Theory - S. Arumugam, S. Ramchandran, Scitech Publication (India) Pvt. Ltd, Chennai.
4. A First Course in Graph Theory - S. A. Choudum, Macmillan India Limited, SBN 033392 040 6.
5. Graph Theory – G. Suresh Singh, Prentice Hall of India,.

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Gujarat University
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
MAT 311 (Elective Course): Convex Analysis and Probability Theory (Theory)

Hours: 3 /week **Credits: 2**

Unit I:

Convex Analysis: Convex and concave sets, Affine sets & Hyperplanes, Convex combination, Convex cones, Algebra of convex sets: Convex functions and discussion of its continuity, graphs, sequences, limits, maxima & minima, monotonicity, linearity on an interval & convex sets, Convexity & connectedness and discussion of differentiability of convex functions. Examples, counter examples and theorems based on them.

Unit II:

Jensen inequality and its consequences & related results. A.M., G.M., Quadratic Mean (Q.M) inequality, logarithmic mean and convexity. Problems, Lagrange Mean Value Theorem(LMVT) & Convexity. Probability as a stochastic (uncertainty) mathematical model. Axiomatic & classical definition of probability, Sample space, events, probabilistic 2-set, 3-set, n-set. Inclusion & Exclusion and examples: Box office queue, Birthday problems, Bertrand's paradox. Independent, Conditional & geometric probability. Law of total probability.

Unit III:

Random walk & Random variable, Baye's Rule. Classical problems: Shakespeare's monkey Eccentric Warden, 3-prisoner's Dilemma, D'Alembert's Confusion Gambler's Ruin etc. Expected values & variance Binomial poison & normal Distributions Banach match-box problem & some classical problems.

Text Books:

1. Convex Analysis By R.Tyrrell Rockafellor, Princeton Uni. Press.
2. A course in Calculus & Real Analysis By Sudhir R. Ghorpade & Balmohan V. Limaye, Springer India. Pages:23, 24, 25, 34, 36,(ex.27 to 35), 42, (ex.71, 72), 74 to 77, 100, 102, 125 to 130 (ex.15), 174 (ex.12)
3. Probability: An Introduction By David A. Santos Viva Books Ch.3 & 4

Reference Books:

1. All the mathematics you missed but Need to Know - Thomas A. Garrity, Camb. Univ. Press.
2. An Introduction to Probability Theory & its Applications - Feller Vol. I John Wiley & sons, NY.
3. Introduction to Probability Models -Sheldom M. Ross, Academic Press, 9th Edition.
4. Probability & Probability Distributions (MS-8, Block:3), IGNOU, New Delhi.
5. Elementary Probability Theory - Chung, Springer, India.
6. What is Mathematics? - Courant & Robbins, Revised by Ian Stewart Pg.108 to 116.
7. Calculus, once again (for convex function & monotonicity) - David A. Santos.
8. Convex functions - A.W.Roberts and D.E.Varberg. Academic press.
9. Lecture slides on Convex Analysis & Optimization - Dimitri P. Bertsekas, MIT cambridge MASS.
10. Convex Analysis by Jose' De Dona; The Uni. of New Castle.
11. A course in Multivariable Calculus & Analysis - S. R. Ghorpade & B. V. Limaye Springer (India) pg:8, 9, 25, 26, 35(ex 5, 6, 7, 8), 37 (ex 23, 24, 25, 58 to 60 (for continuity & Convexity) Pg:125 & 126, 129 to 137.
12. Convex Analysis: An Introductory Text - J. Van Tid, John Wiley, New York.

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Gujarat University

Choice Based Credit System (CBCS)

Syllabus for B. Sc. Semester VI (Mathematics)

MAT 311 (Elective Course):Mechanics (Theory)

Hours: 3 /week **Credits: 2**

Unit I:

Foundation of Mechanics- The ingredients of mechanics (particles, mass, rigid bodies, events, frame of reference, time, units, rest of motion, force), Introduction of vectors, velocity and acceleration. Fundamental laws of Newtonian mechanics. The theory of dimensions.

Unit II:

Methods of Plane Statics- Equilibrium of a particle, Equilibrium of a system of particles, the moment of a vector about a line, the theorem of verignon, necessary condition for equilibrium equipollent system of forces, couples, reduction of a general plane force system, work, the principle of virtual work, sufficient condition for the equilibrium of a rigid body movable parallel to a fixed plane. Potential energy

Unit III:

Mass centers and centre of gravity, Theorem of Pappus, gravitation, centre of gravity. Friction, laws of Static and kinetic friction, thin beams, flexible cables, differential equation of flexible cables, the suspension bridge, the common catenary, cables in contact with smooth curves, cables in contact with rough curves,

Text Book:

Principles of Mechanics - John L. Synge and Byron A. Grifith . Mc Graw Hill Book Comp.- New Delhi.

Reference Books:

1 Introduction to classical Mechanics - R. G. Takwale & P. S. Puranik. Mc Graw Hill Book Comp.-New Delhi.

2 A Text Book on Mechanics - P. N. Sinhal & S. Sareen, Anmol Publications Pvt. Ltd., New Delhi

3 Classical Mechanics - Herbert Goldstein, Addison –Wesley Publishing Company, INC.

4 Classical Mechanics – T. W. B. Kibble, Longman scientific & Technical Co-published in US with John,Wiley & Sons Inc., New-York.

5 Mechanics - S. L. Kalani, C. Hemrajani, Shubhara Kalani, Viva Books Pvt. Ltd., New Delhi ISBN-10: 81-309-0058-0.

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Gujarat University

Choice Based Credit System (CBCS)

Syllabus for B. Sc. Semester VI (Mathematics)

MAT 311 (Elective Course):Cryptography (Theory)

Hours: 3 /week **Credits: 2**

UNIT I:

Rings, Modular Arithmetic, Prime Numbers, Primitive Elements, Discrete Logarithm

UNITII:

Conventions in Representation, Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, A Case for Modern Cryptography.

UNIT III:

Trapdoor Function, Diffie-Hellman(DH) Algorithms for Key Exchange, Algorithms for Discrete Logarithms, ElGamal Public-Key Cryptosystem, RSA Cryptosystem, Digital Signature.

Text Book:

Cryptography and Security - C K Shyamala, N Harini and Dr T R Padmanabhan Wiley-India. Ch-1(omit1.5.6), ch-2(omit 2.9), ch-5(up to 5.5), ch-7.5(up to 7.5.2).

Reference Book:

1. Cryptography & Network Security - Behrouz A Forouzan and Debdeep Mukhopadhyay, McGraw Hill.
2. Cryptography - Atul Kahate.
3. Cryptography and information Security - V K Pachgrare, PHI, EEE.
4. Public-Key Cryptography Theory and Practice - Abhijit Das, Madhvan and C E Veni Pearson.

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Gujarat University
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
MAT 311 (Elective Course): Operations Research (Theory)

Hours: 3 /week **Credits: 2**

Unit I: Inventory Problems

Introduction, types of inventory, cost involved in inventory problems, notations, EOQ model, limitations of EOQ formula, EOQ model with finite replenishment rate, EOQ model with shortages, Order – level Lot – size model, Order – level Lot – size model with finite replenishment rate.

Unit II: PERT and CPM

Introduction, origin of PERT & CPM, applications of PERT & CPM, framework of PERT & CPM, construction of project network, dummy activities and events, rules for network construction, finding the critical path, concepts of float, total float and free float and its interpretations.

Unit III: Game Theory

Introduction, Two person zero-sum games, Maximin and Minimax Principles, Mixed strategies, expected pay-off, solution of 2×2 mixed strategy game, solution of mixed strategy game by the method of oddments, Dominance Principle, solution of mixed game by matrix method, solution of a two person zero-sum $2\times n$ game, Algebraic method for solving a game, solution of 3×3 games with mixed strategy by the method of oddments, Iterative method for approximate solution.

Text Book:

Operations Research - Nita H. Shah, Ravi M. Gor and Hardik Soni, PHI learning.
Chapter 11 (11.1 – 11.10), Chapter 15 (15.1 – 15.9) and Chapter 18 (18.1 – 18.14).

Reference books:

1. Operations Research by J. K. Sharma.
2. Operations Research by S. D. Sharma.
3. Operations Research by Man Mohan, Kanti Swaroop and P. K. Gupta.

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Gujarat University

Choice Based Credit System (CBCS)

Syllabus for B. Sc. Semester VI (Mathematics)

MAT 311 (Elective Course):Bio-Mathematics (Theory)

Hours: 3 /week **Credits: 2**

Unit I:

Mathematical Models in epidemiology : Basic concepts, SI model, SIS model with constant coefficient, SIS model with coefficient as a function of time t, SIS model with constant number of carriers, SIS model when the carriers is a function of time t, SIR model, Epidemics with vaccination.

Unit II:

Single-species population models – Age structured : Continuous-time continuous-Age-Scale population models, Lotka's model for population growth, Discrete-Time Discrete-Age-Scale population model, Bernardelli, Lewis and Leslie (BLL) model, Density Dependence model, Two-sec models, Continuous-time Discrete-Age population model.

Unit III:

Single-species population models – non-age structured : Exponential Growth model, its formulation, solution and interpretation, Effects of immigration and Emigration on population, Logistic Growth model, its formulation, solution and interpretation.

Text Book:

Bio-Mathematics - S. K. Aggarwal, ALP Books.

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Gujarat University
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
MAT 312:Practical-1(Based on MAT307, MAT308)

Hours: 6 /week **Credits: 2.5**

List of Practicals:

Unit I:

1. Verification of Rings, Commutative ring and ring with unity. Finite rings and their operation tables.
2. Examples of Ideals and Integral Domain.
3. Examples of finite fields and extension fields.
4. Construction of quotient ring and their operation tables.

Unit II:

5. Find the g.c.d. of two given polynomials and express it as a linear combination of these two polynomials.
6. Check the irreducibility of polynomial over the given field (By different methods)
7. Factorization of polynomial and the rational zeros of given polynomial.
8. Example of Maximal and prime ideal

Unit III:

9. Definition and evaluation of Riemann integrals by various methods
10. Verifying MVTs and problems based on Fundamental Theorem of Integration
11. Convergence of infinite series of positive terms
12. Absolute convergence, root and ratio tests using limit inferior and superior

Unit IV:

13. Power Series, radius of convergence
14. Improper integrals
15. Power series expansion of functions.
16. Power series solutions of differential equations

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Gujarat University
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
MAT 312:Practical-2(Based on MAT309, MAT310)

Hours: 6 /week **Credits: 2.5**

List of Practicals:

Unit I:

1. Metric spaces, examples
2. Uniform convergence of sequences
3. Uniform convergence of series , tem by term differentiation and integration
4. Multiplication of power series

Unit II:

5. Properties of exponential, logarithmic and trigonometric functions
6. Compact and connected spaces/project/paper
7. One article to be chosen from journals/books and presented in own words with proofs
8. One article to be chosen from journals/books and presented in own words with proofs.

Unit III:

9. Using the adjacency matrix determine weather the given graph is connected or not.
10. Determine weather the given graph is connected or not using fusion algorithm.
11. Find a minimal spanning tree of a given connected weighted graph using Kruskal's algorithm.
12. Find a minimal spanning tree of a given connected weighted graph using Prim's algorithm.

Unit IV:

13. Find a shortest path between two vertices of a given connected graph using the Breadth First Search algorithm.
14. Find a shortest path between two vertices of a given connected graph using the Back-tracking algorithm.
15. Find a shortest path between two vertices of a given connected weighted graph using the Dijkstra's algorithm.
16. Construct an Euler tour in a Euler graph using Fleury's algorithm.

References:

1. www.mathworld.com.
2. Selected Papers On Precalculus: Vol I – Edited by Tom M Apostol: The Mathematical Association of America:(MAA):ISBN 0-88385-200-4.
3. Selected Papers On calculus: Vol II – Edited by Tom M Apostol: The Mathematical Association of America:(MAA):ISBN 0-88385-200-4.
4. Resonance: The Indian Academy of Sciences: ISSN 0971-8044 .

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