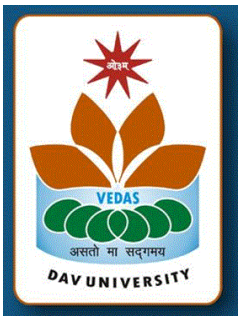
DAV UNIVERSITY, JALANDHAR



Course Scheme & Syllabus
For
B.Sc. (Hons.) Mathematics
(Program ID-29)
(As per Choice Based Credit System)

1st to 6th SEMESTER
Examinations 2022–2023 Session Onwards
Syllabi Applicable For Admissions in 2022

Mission of the Programme

The mission of the B.Sc. (Hons.) Mathematics Programme is to:

- Provide a broad and comprehensive knowledge of core areas of pure and applied mathematics in a supportive teaching environment.
- To stimulate an interest among students in all aspects of modern mathematics.
- To foster skills including problem solving, communication, team work and the ability to work individually on complex problems.

Programme Learning Outcomes

Upon completion of the B.Sc. (Hons.) Mathematics programme, students will be able to:

- Apply the underlying unifying structures of mathematics (i.e. sets, relations and functions, logical structure) and the relationships among them.
- Demonstrate proficiency in writing proofs.
- Communicate mathematical ideas both orally and in writing.
- Function on multidisciplinary teams by working cooperatively, creatively and responsibly as a member of a team.
- Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.
- Recognize the need to engage in lifelong learning through continuing education and research.

Scheme of B.Sc. (Hons.)

B.Sc. (Hons.) Mathematics
Semester 1

S. No.	Course Code	Course Title	Course Type	L	T	P	Cr.
1	MTH 121A	Calculus	Core	4	0	0	4
2	MTH 122	Calculus Lab	Core	0	0	4	2
3	MTH 123A	Algebra	Core	5	1	0	6
4	ENG 151B	Basic Communication Skills	AECC	3	0	0	3
5	ENG152A	Basic Communication Skills Lab		0	0	2	1
6	CSA171	Computer Fundamentals and Programming Using C	AECC	4	0	0	4
7	CSA172	Computer Fundamentals and Programming Using C Lab	AECC	0	0	4	2
8	Generic Elective-I		GE				6
	Total						28

GE (Generic Elective-I) (Choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	PHY 153A	Optics and Lasers	4	0	0	4
	PHY 154	Optics and Lasers Lab	0	0	4	2
2	CHE153	Organic Chemistry	4	0	0	4
	CHE154	Organic Chemistry Lab	0	0	3	2
3	MTH 140	Finite Element Methods	5	1	0	6
4	ECO 214A	Econometrics	5	1	0	6

Semester 2

S. No.	Course Code	Course Title	Course Type	L	T	P	Cr.
1	MTH 127	Theory of Equations	Core	5	1	0	6
2	MTH 128	Differential Equations	Core	4	0	0	4
3	MTH 129	Differential Equations Lab	Core	0	0	4	2
4	EVS 100	Environmental Studies	AECC	4	0	0	4
5	ENG 352	Professional Communication	AECC	3	0	0	3
6	SGS 107	Human value and General Studies	AECC	4	0	0	4
7	Generic Elective-II		GE				6
	Total						29

GE (Generic Electives)-II) (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	PHY 155A	Modern Physics	4	0	0	4
	PHY 156	Modern Physics Lab	0	0	4	2
2	CHE155	Spectroscopy	4	0	0	4
	CHE156	Spectroscopy Lab	0	0	3	2
3	MTH 141	Mathematical Finance	5	1	0	6

Semester 3

S. No.	Course Code	Course Title	Course Type	L	T	P	Cr.
1	MTH 222	Group Theory I	Core	5	1	0	6
2	MTH 229	Real Analysis	Core	5	1	0	6
3	MTH 231	Partial Differential Equations	Core	4	0	0	4
4	MTH 232	Partial Differential Equations Lab	Core	0	0	4	2
5	Skill Enhancement Course-I		SEC	2	0	0	2
6	Generic Elective-III		GE				6
	Total						26

SEC (Skill Enhancement Course)-I (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	MTH 142	Logic and Sets	2	0	0	2
2	CSA 260	Operating systems	2	0	0	2
3	MTH 146	Vedic Mathematics	2	0	0	2

GE (Generic Electives-III) (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	PHY253A	Electricity and Magnetism and Electronics	4	0	0	4
	PHY254	EM and Electronics Lab	0	0	4	2
2	CHE253	Inorganic Chemistry	4	0	0	4
	CHE254	Inorganic Chemistry Lab	0	0	3	2
3	MTH 143	Applications of Algebra	5	1	0	6

Semester 4

S. No.	Course Code	Course Title	Course Type	L	T	P	Cr.
1	MTH 221	Theory of Real Functions	Core	5	1	0	6
2	MTH 225A	Numerical Methods	Core	4	0	0	4
3	MTH 226	Numerical Methods Lab	Core	0	0	4	2
4	MTH 234	Analytical Geometry	Core	5	1	0	6
5	Skill Enhancement Course-II		SEC	2	0	0	2
6	Generic Elective-IV		GE				6
	Total						26

SEC (Skill Enhancement Course)-II (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	MTH 144	Latex and HTML	0	0	4	2
2	CSA 261	Data Base Management Systems	2	0	0	2
3	Swachh Bharat Summer Internships		0	0	4	2

GE (Generic Electives)-IV (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	PHY 353A	Mechanics and Waves	4	0	0	4
	PHY 354	Mechanics and Waves Lab	0	0	4	2
2	CHE353	Physical chemistry	4	0	0	4
	CHE354	Physical chemistry Lab	0	0	3	2
3	CSA 210	Programming in C+ +	4	0	0	4
	CSA 216	Programming in C+ + Laboratory	0	0	4	2
4	MTH 145	Combinatorial Mathematics	5	1	0	6

Semester 5

S. No.	Course Code	Course Title	Course Type	L	T	P	Cr.
1	MTH 341	Mechanics I	Core	5	1	0	6
2	MTH 345	Riemann Integration and Series of Functions	Core	5	1	0	6
3	Discipline Specific Elective-I		DSE	5	1	0	6
4	Discipline Specific Elective-II		DSE	5	1	0	6
	Total						24

DSE (Discipline Specific Electives)-I (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	MTH 324	Number Theory	5	1	0	6
2	MTH 327	Discrete Mathematics	5	1	0	6
3	MTH 340	Project				6

DSE (Discipline Specific Electives)-II (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	MTH 326	Industrial Mathematics	5	1	0	6
2	MTH 322	Group Theory II	5	1	0	6
3	MTH 328	Probability and Statistics	5	1	0	6

Semester 6

S. No.	Course Code	Course Title	Course Type	L	T	P	Cr.
1	MTH 321	Multivariate Calculus	Core	5	1	0	6
2	MTH 344	Mechanics II	Core	5	1	0	6
3	Discipline Specific Elective-III		DSE	5	1	0	6
4	Discipline Specific Elective-IV		DSE	5	1	0	6
	Total						24

DSE (Discipline Specific Electives)-III (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	MTH 343	Metric Spaces and Complex Analysis	5	1	0	6
2	MTH 332	Bio-Mathematics	5	1	0	6
3	MTH 333	Linear Programming	5	1	0	6

DSE (Discipline Specific Electives)-IV (choose one)

S. No.	Course Code	Course Title	L	T	P	Cr.
1	MTH 334	Mathematical Modeling	5	1	0	6
2	MTH 347	Ring Theory and Linear Algebra I	5	1	0	6
3	MTH 336	Differential Geometry	5	1	0	6

Course Title: Calculus

L	T	P	Credits
4	0	0	4

Course Code: MTH 121A

Course Objective: Calculus is one of the major branches of mathematics that finds application in almost all the fields of science. This course is an introduction to calculus. Students will be introduced to the concepts of limits, derivatives, integrals and infinite series.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Solve higher order derivatives of hyperbolic and exponential functions
CO2: Employ the concepts of asymptotes, and inflexion points in tracing of Cartesian curves and compute the reduction formulae of standard functions with applications.
CO3: Apply derivatives to find area and volumes of surface of revolution
CO4: Understand continuity and differentiability in terms of limits of vector valued functions

UNIT-A **13 HOURS**

definition of Limit, continuity, one-sided limit, limits involving infinity.
Higher order derivatives, L' Hospital's rule, Leibniz rule and its applications, concavity and inflection points, asymptotes.

UNIT-B **14 HOURS**

Curve tracing in Cartesian coordinates, tracing of standard curves in polar coordinates, Reduction formulae, derivations and illustrations of reduction formulae.

UNIT-C **14 HOURS**

Parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics, reflection properties of conics, rotation of axes and second-degree equations, classification into conics using the discriminant, polar equations of conics.

UNIT-D **15 HOURS**

Volumes by slicing; disks and washer's methods, Volumes by cylindrical shells, Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector valued functions, differentiation and integration of vector valued functions, tangent and normal components of acceleration.

Books Recommended

1. Thomas, George B., and Finney Ross L. Calculus. Pearson Education, 9th Ed, 2010.

2. Strauss, M.J., and G.L. Bradley and K. J. Smith. Calculus. Delhi: Dorling Kindersley (India) P. Ltd. (Pearson Education), 3rd Ed, 2007.

3. Anton, H., and I. Bivens, and S. Davis. Calculus. Singapore: John Wiley and Sons (Asia) P. Ltd., 7th Ed. 2002.

4. Courant, R., and F. John. Introduction to Calculus and Analysis. New York: Springer-Verlag (Volumes I & II), 1989.

Course Title: Calculus Lab

L	T	P	Credits
0	0	4	2

Course Code: MTH122

Course Objective: The objective of this course is to teach Calculus as a laboratory science with the computer and software. The aim is to use this software as an essential tool in learning and using calculus.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Solve higher order derivatives of hyperbolic and exponential functions.
CO2: Employ the concepts of asymptotes, and inflexion points in tracing of Cartesian curves and compute the reduction formulae of standard functions with applications.
CO3: Apply derivatives to find area and volumes of surface of revolution.
CO4: Understand continuity and differentiability in terms of limits of vector valued functions.

List of Practical's (using any software)

1. Matrix operation (addition, multiplication, inverse, transpose).

2. Plotting of graphs of function and to illustrate the effect of and on the graph.

3. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

4. Sketching parametric curves (e.g. Trochoid, cycloid, epicycloids, and hypocycloid).

5. Obtaining surface of revolution of curves.
6. Tracing of conics in Cartesian coordinates/ polar coordinates.
7. Sketching ellipsoid, hyperboloid of one & two sheets, elliptic cone, elliptic, parabolic, hyperbolic paraboloid using Cartesian coordinates.

Books Recommended

1. Thomas, George B., and Finney Ross L. *Calculus*. Pearson Education, 9th Ed, 2010.
2. Strauss, M.J., and G.L. Bradley and K. J. Smith. *Calculus*. Delhi: Dorling Kindersley (India) P. Ltd. (Pearson Education), 3rd Ed, 2007.
3. Anton, H., and I. Bivens, and S. Davis. *Calculus*. Singapore: John Wiley and Sons (Asia) P. Ltd., 7th Ed. 2002.
4. Courant, R., and F. John. *Introduction to Calculus and Analysis*. New York: Springer-Verlag (Volumes I & II), 1989.

Course Title: Algebra

L	T	P	Credits
5	1	0	6

Course Code: MTH 123A

Course Objective: The concepts and techniques from linear algebra are of fundamental importance in many scientific disciplines. The main objective is to introduce basic notions in linear algebra that are often used in mathematics and other sciences. The emphasis will be to combine the abstract concepts with examples in order to intensify the understanding of the subject.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand De Moivre's theorem and apply De Mover's theorem to solve numerical problems.
CO2: Understand basic notions, functions and Fundamental Theorem of Arithmetic in linear algebra that are often used in mathematics and other sciences.
CO3: Discuss the vector spaces, subspaces and their properties and visualize the linear transformation by matrices.
CO4: Determine eigenvalues and corresponding eigenvectors for a square matrix and understand Cayley Hamilton Theorem.

UNIT-A **15 HOURS**

Deeper look at complex numbers, De Moivre's theorem and its applications, Primitive nth roots of unity Expansion of in terms of of multiple of summation of a trigonometric series.

UNIT-B **15 HOURS**

Division algorithm, greatest common divisor of integers and its expression as linear combination of given integers, Divisibility and Euclidean algorithm, Basic properties of Congruence relation between integers, Statement of Fundamental Theorem of Arithmetic.

UNIT-C **15 HOURS**

Rank of a matrix, echelon form of a matrix, normal form of a matrix, linear dependence and independence of vectors, n-vector space, Subspaces of , dimension of subspaces of , introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices.

UNIT-D **15 HOURS**

Systems of linear equations (homogeneous and non-homogeneous systems), solution sets of linear systems, applications of linear systems. Eigen values, Eigen Vectors and Characteristic Equation of a matrix, Cayley-Hamilton Theorem.

Books recommended

1. Andreescu, Titu and Dorin Andrica. *Complex Numbers from A to Z,* Birkhauser, 2006.
2. Lay, David C. *Linear Algebra and its Applications, 3rd Ed.* Pearson Education Asia, Indian reprint, 2007.
3. Goodaire, Edgar G. and Michael M. Parmenter. *Discrete Mathematics with Graph Theory, 3rd Ed.* Pearson Education (Singapore) P. Ltd. Indian reprint, 2005.
4. Friedberg, S.H., A.J. Insel and L.E. Spence. *Linear Algebra*. Prentice Hall, 2003.
5. Hoffman, K. and R. Kunze. *Linear Algebra, 2nd Edition*. Prentice-Hall of India, 1989.

6. Lang, S. *Linear Algebra, Undergraduate Texts in Mathematics.* Springer-Verlag, New York, 1989.
7. Lax, P. *Linear Algebra*. John Wiley & Sons, New York. Indian Ed. 1997.
8. Lipschutz, Seymour and Lipson, Marc *Schaum's Outline of Linear Algebra*, 3rd Edition, Mcgraw Hill Education, 2017.

Course Title: Basic Communication Skills

Course Code: ENG151B
Total Lectures: 60

L	T	P	Credits	Marks
3	1	0	3	100

Course Objective:

- To enhance students' vocabulary and comprehension skills through the prescribed texts.
- To hone students' reading and writing skills.
- To teach the rules of English grammar descriptively.
- To make students aware about the socio-cultural aspect of English.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1:. Have developed a wide vocabulary and be able to summarize ideas.
CO2: Be able to read and analyze texts and display competence in written communication.
CO3: Show a considerable understanding of English Grammar.
CO4: Demonstrate sensitivity to cultural differences while communicating

Unit – A

1. **Applied Grammar (in Socio-Cultural Context)**

- Tenses
- Passives
- Reported/Reporting Speech

Unit – B

1. **Reading (Communicative Approach to be Followed)**

- Nissim Ezekiel : The Patriot (Poem)

(Sub-topic: Basic Introduction to Indianisms and Difference between Indian English & Standard English)

1. **Writing**

- Paragraph Writing : Topic Sentence, Inductive logic, and Deductive logic
- Essays: Narrative, Descriptive, Expository, and Persuasive
- Notice: Format, Characteristics, and 5 W's,

- Email: Structure, Characteristics of Effective Emails, and Advantages

Unit – C

1. **Applied Grammar (in Socio-Cultural Context)**

- Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, and Interjection
- Modals: Can, Could, May, Might, Will, Would, Shall, Should, and Must

Unit – D

1. **Reading (Communicative Approach to be Followed)**

Alleen Pace Nilsen: Sexism in English (Prose)

(Sub-topic: Relationship between Society & Language and Sexist Language)

2. **Writing**

Letter Writing: Formal and Informal

Teaching Methodology:

a. **Grammar:** Grammar must be taught descriptively in socio-cultural context. The contextual teaching of grammar helps a learner understand the application of grammar rules in real life situations. The learner who learns grammar in isolation is unable to use the language fluently, whereas the learner who learns grammar in context uses the language confidently and fluently in real life situations.

b. **Literary Texts:** Communicative approach should be followed to teach the texts. Classroom activities guided by the communicative approach are characterised by trying to produce meaningful and real communication, at all levels. As a result there may be more emphasis on skills than systems, lessons are more learner-centred, and there may be use of authentic materials.

Teachers can introduce the topic or theme of the text, pre-teach essential vocabulary items and use prediction tasks to arouse the interest and curiosity of students.

c. **Writing**: Some of the strategies that should be adopted are as follows:

- Regularly assign brief writing exercises in your classes.
- Provide guidance throughout the writing process, i.e. Pre-Writing, Drafting, Revising, Editing, and Publishing.
- Give students opportunities to talk about their writing.
- Encourage students to revise their work.

a. **Testing**: The examinations will be conducted as per the norm of the university.

References:

a. **Books**

1. Eschholz, Paul and Rosa, Alfred (ed.), *Subject and Strategy*. NY: St. Martin's Press, 1978. Print.
2. Ezekiel, Nissim. *Collected Poems 1952-1988*. New Delhi: Oxford University Press, 1999. Print.
3. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
4. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.
5. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
6. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
7. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
8. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
9. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

a. **Websites**

1. www.youtube.com (to watch standard videos)
2. http://learnenglish.britishcouncil.org/en
3. https://owl.english.purdue.edu/

Course Title: Basic Communication Skills Lab

L	T	P	Credits
0	0	2	1

Course Code: ENG152A

No. Of Lectures: 30

Course Objective:

- To improve the preparation and presentation competencies necessary for oral communication in a variety of contexts, as both a speaker and a listener.
- To improve pronunciation.
- To promote interactive skills through Group Discussions and role plays.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Develop proper listening skills.
CO2: Articulate and enunciate words and sentences clearly and efficiently
CO3: Show confidence and clarity in public speaking projects.

Unit – A Speaking and Listening
● IPA for Language Learning - Basic Phonetics
● Movie-Clippings
● Role Plays
● Group Discussions
● Mock Interviews

Project File: Each student will prepare a project file on any of the topics given by class teacher. Student should be able to justify the contents of his/her scrap file. The file must be handwritten, not typed. Students must acknowledge all the sources of information in his/her scrap file.

Reference Books

1. Gangal, J. K. *A Practical Course In Spoken English.* India: Phi Private Limited, 2012. Print.
2. Kumar, Sanjay and PushpLata. *Communication Skills*. India: OUP, 2012. Print.

Websites

1. www.youtube.com (to download videos for panel discussions)
2. www.englishforeveryone.org
3. www.talkenglish.com
4. www.mindtools.com

Course Title: Computer Fundamentals and Programming using C

L	T	P	Credits
4	0	0	4

Course Code: CSA171
Course Duration: 45-60 Hours

Course Objective: This course will enable the student to gain an understanding of the core concepts and technologies which constitute Information Technology. The objective of this course is to help the students in finding solutions to various real life problems and converting the solutions into computer program using C language (structured programming).

UNIT-A

Computer Fundamentals **12 Hours**

- Block Structure of a Computer, Characteristics of Computers
- Computer generations, Applications of Computers.

Number System

- Bit, byte, binary, decimal, hexadecimal, and octal systems, conversion from one system to the other, representation of characters, integers and fractions. Addition, subtraction, multiplication and division of binary numbers.

Memory Types

- RAM, ROM, Cache and Secondary memory.

Input and Output Devices

- Keyboard, Mouse, Monito, Light pen, Joystick, Mouse, Touch screen; OCR, OMR, MICR.
- Impact, nonimpact, working mechanism of Drum printer, Dot Matrix printer, Inkjet printer and Laser printer, plotters.

UNIT-B **13 Hours**

Fundamentals of C

- Character Set, Identifiers and Key Words, Data Types
- Constants, Variables, Expressions, Statements, Symbolic Constants.

Operations and Expressions

- Arithmetic Operators, Unary Operators, Relational Operators,
- Logical Operators, Assignment and Conditional Operators, Library functions.

Data Input and Output

- Single Character Input, Single Character Output, Entering Input Data
- More About Scan Functions, Writing Output Data, More About Print Functions
- Gets and Puts Functions, Interactive Programming.

UNIT-C **13 Hours**

Control Structures

- Introduction, Decision Making with If – Statement, If Else and Nested If,
- While And Do-While, For Loop.
- Jump Statements: Break, Continue, Goto, Switch Statement.

Functions

- Introduction To Functions, Function Declaration, Function Categories
- Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference
- Recursion, Global and Local Variables, Storage Classes.

Arrays

Introduction to Arrays, Array Declaration, Single and Multidimensional Array, Memory Representation, Matrices, Strings, String Handling Functions.

UNIT-D **10 Hours**

Structure and Union

- Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions.

Pointers

- Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers,
- Assignment through Pointers, Pointers and Arrays.

Files

- Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File.

Preprocessor Directives

Introduction and Use, Macros, Conditional Preprocessors, Header Files

Reference Books

1. Kanetkar Yashvant P, *Let us C*, New Delhi :BPB Publications, Seventh Edition (2007).
2. Balagurusami E, *Programming in ANSI C*, New Delhi: Tata McGraw Hill, Fourth Edition (2010).
3. Gottfried Byron S., *Programming in C*, New Delhi: McGraw Hills, Second Edition 1996.
4. Kernighan & Richie,*The C Programming Language*, New Delhi: PHI Publication, Second Edition(2009) .
5. Gottfriet Bryon, *Schaum Outline Series, Programming in C*, New Delhi: McGraw Hills, 2010

6.Sinha, P.K. and Sinha, P., Foundations of Computing. New Delhi: BPB First Edition, 2002.
7.Norton Peter , Introduction to Computers, McGraw Hill.
8.Rajaraman V, Fundamentals of Computers, New Delhi: Prentice Hall of India, Second Edition, 1996.

Course Title: Computer Fundamentals and Programming using C Laboratory
Course Code: CSA172

L	T	P	Credits
0	0	4	2

Implementation of C programming concepts:

- Control Structures, Loops, Arrays, Strings
- Functions, Structures, Union, Files, etc.

Course Title: Theory of Equations

L	T	P	Credits
5	1	0	6

Course Code: MTH 127

Course Objective: The aim of this course is to study general properties of polynomials and to find the roots of different types of polynomials.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn general properties of polynomials and equations, nature of roots of an equation and relation between roots and coefficients.
CO2: Solve the reciprocal equations. Transform the equation according to various given conditions and to solve cubic and biquadratic equations
CO3: Find the sum of the power of the roots of an equation using Newton's Method.
CO4: Location and nature of roots by Sturm's method. Condition for an equation to have real roots. Obtain integral and real roots of an equation.

UNIT-A **15 HOURS**

General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of polynomials, General properties of equations, Fundamental theorem of algebra, Product form of an algebraic equation, Repeated factors, equal roots, Descarte's rule of signs positive and negative rule, Complex root, Relation between the roots and the coefficients of equations.

UNIT-B **15 HOURS**

Symmetric functions, Applications of symmetric functions of the roots, Transformation of equations, Reciprocal equations, Binomial equations, Solutions of reciprocal equations, Euclidean construction of the regular polygon, Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

UNIT-C **15 HOURS**

Powers of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

UNIT-D **15 HOURS**

Separation of the roots of equations, Strums theorem, Applications of Strum's theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations. Newton's method and Horner's method for solving an equation.

Books Recommended

1. Burnside, W. S. and A. W. Panton. The Theory of Equations. Dublin & London: Dublin University Press, 1954. Print

2. MacDuffee, C. C. Theory of Equations. John Wiley & Sons Inc., 1954. Print

3. Turnbull, H.W. Theory of equations. London & New York, Interscience Publishers, Inc., 1947 Print

Course Title: Differential Equations

L	T	P	Credits
4	0	0	4

Course Code: MTH 128

Course Objective: The objective of this course is to equip the students with knowledge of some advanced concepts related to differential equations and to understand some basic approach to mathematical oriented differential equations.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Students will be able to demonstrate competence in finding solutions of linear differential equations of first order.
CO2: Students will be able to demonstrate competence in finding solutions of differential equations of first order and higher degree.
CO3: Students will be able to demonstrate competence in finding solutions of linear differential equations of higher order with constant coefficients.
CO4: Students will be able to demonstrate competence in making mathematical model of some real life problems.

UNIT-A **15 HOURS**

Basic definitions: order and degree of differential equation, formulation of differential equations. General, particular, explicit, implicit and singular solutions of a differential equation, integral curves, isoclines.

Linear and reducible to linear differential equations, Leibnitz and Bernoulli Equations, variables separable and equations reducible to this form, homogeneous equations and equations reducible to homogeneous form. Exact differential equations and integration factors. Bernoulli equations and Geometrical interpretation of first order differential equation, applications.

UNIT-B **12 HOURS**

Equations solvable for , equations solvable for , equations solvable for , equations in Clairaut's form and equations reducible to Clairaut's form.

Extraneous Loci: Definition, Tac locus, the Node locus, Cusp locus.

UNIT-C **13 HOURS**

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients and reducible to constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

UNIT-D **12 HOURS**

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

Books Recommended

1. Ross S.L. *Differential Equations*, 3rd edition. India: John Wiley and Sons, 2004.
2. Rai B., Choudhury D. P. and Freedman H. I. *A Course in Ordinary Differential Equations.* Alpha Science International Ltd. 2012.
3. Codington E.A. *An Introduction to Ordinary Differential Equation*. New York: Dover Publications, 1989.
4. Barnes, Belinda and Glenn R. Fulford. *Mathematical Modeling with Case Studies: A Differential Equation Approach using Maple and MATLAB, 2nd Ed.* London and New York: Taylor and Francis group, 2009.
5. Singhania R., *Ordinary and Partial Differential Equations*. New Delhi: S. Chand and Company, 2006.

Course Title: Differential Equations Lab
Course Code: MTH 129

L	T	P	Credits
0	0	4	2

Course Objective: The objective of this course is to teach Differential as a laboratory science with the computer and software. The aim is to use this software as an essential tool in learning and using Differential.

1. Plotting of first order solution family of differential equation.
2. Plotting of second order solution family of differential equation.
3. Plotting of third order solution family of differential equation.
4. Growth model (Exponential case only).
5. Decay model (Exponential case only).
6. Lake pollution model (with constant/seasonal flow and pollution concentration).
7. Case of single cold pill and a course of cold pills.
8. Limited growth of population (with harvesting).
9. Limited growth of population (without harvesting).

Books Recommended

1. Barnes, Belinda and Glenn R. Fulford. *Mathematical Modeling with Case Studies: A Differential Equation Approach using Maple and MATLAB, 2nd Ed.* London and New York: Taylor and Francis group, 2009.

2. Edwards, C.H. and D.E. Penny. *Differential Equations and Boundary Value problems Computing and Modeling.* India: Pearson Education, 2005.

3. Abell, Martha L and James P Braselton. *Differential Equations with MATHEMATICA, 3rd Ed.* Elsevier Academic Press, 2004.

Course Title: Environmental Studies

L	T	P	Credits	Marks
4	0	0	4	100

Course Code: EVS100
Total Lectures: 60

Course Objective: This course aims at understanding the students in aspects of environmental problems, its potential impacts on global ecosystem and its inhabitants, solutions for these problems as well as environmental ethics which they should adopt to attain sustainable development.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand the interconnected and interdisciplinary nature of environmental studies and develop critical thinking skills in relation to environmental affairs. Acquire knowledge about the depletion of the root cause of natural resources and their effective management.
CO2: To aware about the biodiversity and its importance to mankind**.** Interpret and propose solutions to various environmental pollution, solid waste and disaster management
CO3:Expand awareness of self in a global society and effectively engage diverse perspectives, values, and cultures, ranging from local to global, in dealing with environmental and social issues.
CO4:Awareness about effect of population increase on humans itself. Causes of spread of different diseases in society. How Indian government is supporting women and children that considered weakest section of society.

UNIT I

Introduction to Environmental Studies

- Definition, components and types of Environment.
- Meaning of Environmental Studies and its Multidisciplinary nature;
- Scope and importance; Concept of sustainability and sustainable development.

6 hours

Natural Resources: Renewable and Non--Renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

8 hours

UNIT II

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

2 hours

Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

- India as a mega--biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity: In--situ and Ex--situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

8 hours

UNIT III

Environmental Pollution

Environmental Pollution: types, causes, effects and controls; Air, water, soil and noise pollution

- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

8 hours

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

7 hours

UNIT IV

Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

6 hours

Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site--Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems--pond, river, Delhi Ridge, etc.

5 hours

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36--37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29--64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.

Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton

L	T	P	Credits
3	0	0	3

Course Title: Professional Communication
Paper Code: ENG352

Course Objective: This paper, with a practice-oriented approach, aims to hone students' skills in the major dimensions of professional communication.

Learning Outcome: Students will show adequate understanding of professional communication skills.

PART A

- Professional Communication: Technical Communication and Business Communication
- Verbal and Non-Verbal Communication
- Barriers to Communication

(**N.B.** As the topics are largely theoretical, teacher shall introduce the topics in classroom in the form of lectures and encourage students to read on their own from the reference books. All these topics will be supported by examples from real life situations.)

PART B

- Reading Skills: Active & Passive Reading, Reading strategies, and Developing a Good Reading Speed
- Listening Skills: Types of Listening & Effective Listening Strategies
- Speaking Skills: Basics in Phonetics
- Writing Skills: Topic Sentence and Paragraph (descriptive, narrative, expository, and persuasive) (**N.B.** Teacher will encourage students to apply the theoretical knowledge while practicing the four skills. Opportunities to practice the language skills should be created for students in the classroom.)

PART C

- Conversation: Formal and Informal
- Panel Discussion and Group Discussion
- Oral Presentation

(**N.B.** Teacher will give supporting examples from the industry and encourage students to do relevant exercises.)

PART D

- C.V. and Cover Letter
- Interview Skills
- Professional Letters
- Report Writing and Memo

(**N.B.** Teacher will give supporting examples from the industry and encourage students to do relevant exercises.)

Testing: The examinations will be conducted as per the norm of the university.

References:

3. Crystal, David. The Gift of the Gab – How Eloquence Works. Connecticut: Yale University, 2016. Print.
4. Gangal, J. K. A Practical Course in Spoken English. India: Phi Private Limited, 2012. Print.
5. Hosler, Mary Margaret. English Made Easy. Delhi: McGraw, 2013. Print.
6. Koneru, Aruna. Professional Communication. Delhi: McGraw, 2008. Print.
7. Mahanand, Anand. English for Academic and Professional Skills. Delhi: McGraw, 2013. Print.
8. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. A Workbook on English Grammar and Composition. Delhi: McGraw, 2016. Print.
9. Rizvi, M. Ashraf. Effective Technical Communication. Delhi: McGraw, 2018. Print.
10.Sharma, R.C. and Krishna Mohan. Business Correspondence and Report Writing. Delhi: McGraw, 2013. Print.
11.Suzana, Roopa. A Practical Course in English Pronunciation. Delhi: McGraw Hill Education, 2017. Print.
12. Tyagi, Kavita and Padma Misra. Basic Technical Communication. Delhi: PHI Learning, 2013. Print.

c. Websites

8. www.youtube.com (to watch standard videos)
9. http://learnenglish.britishcouncil.org/en
10. https://owl.english.purdue.edu/

Course Title: Human Values and General Studies

L	T	P	Credits
4	0	0	4

Course Code: SGS107

Total Lectures: 60
Course Objectives

a) To sensitize students about the role and importance of human values and ethics in personal, social and professional life.

b) To enable students to understand and appreciate ethical concerns relevant to modern lives.

c) To prepare a foundation for appearing in various competitive examinations

d) To sensitize the students about the current issues and events of national and international importance

e) To provide opportunity to the students to study inter disciplinary subjects like Geography, Science, Economy, Polity, History, International Relations etc.

UNIT I

Human Values

1. **Concept of Human Values:** Meaning, Types and Importance of Values **2 Hrs**
2. **Value Education :** Basic guidelines for value education **2 Hrs**
3. **Value crisis and its redressal** **1 Hrs**

Being Good and Responsible

1. Self Exploration and Self Evaluation **2 Hrs**
2. Acquiring Core Values for Self Development **2 Hrs**
3. Living in Harmony with Self, Family and Society **3 Hrs**
4. Values enshrined in the Constitution: Liberty, Equality **3 Hrs**
5. Fraternity and Fundamental Duties. **3 Hrs**

UNIT II

Value – based living

1. Vedic values of life **2 Hrs**
2. *Karma Yoga* and *Jnana Yoga* **2 Hrs**
3. *Ashta Marga* and *Tri-Ratna* **2 Hrs**

Ethical Living:

1. Personal Ethics **2 Hrs**
2. Professional Ethics **3 Hrs**
3. Ethics in Education **2 Hrs**

UNIT III

General Geography

World Geography **3 Hrs**

The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest.

Indian Geography **3 Hrs**

Location, Area and Dimensions, Physical Presence, Indian States and Union Territories, Important sites and Monuments, Largest-Longest and Highest in India.

General History **3 Hrs**

Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus

Glimpses of World History **3 Hrs**

Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc.

Indian Polity: Constitution of India **3 Hrs**

Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panachayati Raj System, RTI etc.

General Economy **3 Hrs**

The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.

UNIT IV

General Science **3 Hrs**

General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries

Sports and Recreation **3 Hrs**

The World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours. Famous personalities, Festivals, Arts and Artists

Current Affairs **3 Hrs**

National and International Issues and Events in News, Governments Schemes and Policy Decisions

Miscellaneous Information

Who is who **2 Hrs**

Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports

References:

1. Tripathi,A. N.*Human Values*,New Age International Publishers, New Delhi, Third Edition, 2009
2. Surbiramanian, R. *Professional Ethics*, Oxford University Press, New Delhi, 2013.
3. Anand, R. *Human Values and Professional Ethics*, Satya Prakashan, New Delhi, 2012
4. Bhalla, S.; Prakashan, S. *Human Values and Professional Ethics*, New Delhi, 2012.
5. Soryan, R. *Human Values and Professional Ethics*, Dhanpat Rai & Co. Pvt. Ltd., First Edition, 2010.

6. Jayshree, S.; Raghavan B. S., *Human Values and Professional Ethics,*S. Chand & Co. Ltd. 2007.
7. Singh, Y.; Garg, A. *Human Values and Professional Ethics*, Aitbs publishers, 2011.
8. Vrinder Kumar, *Human Values and Professional Ethics*,Kalyani Publishers, Ludhiana, 2013.
9. Gaur, R.;Sangal, R.; Bagaria,G. P.Human Values and Professional Ethics, Excel Books, New Delhi 2010.
10. Osula, B.; Upadhyay, S.*Values and Ethics,* Asian Books Pvt. Ltd., 2011.
11. Radhakrishnan, S.; *Indian Philosophy,* George Allen & Unwin Ltd., New York: Humanities Press INC, 1929.
12. Dwivedi, A. N. *Essentials of Hinduism, Jainism and Buddhism*, Books Today, New Delhi – 1979
13. Bhan, S. *Dayanand : His life and work*,DAVCMC, New Delhi – 2001.
14. Dwivedi, K. D.*Esence of Vedas*,Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
15. Chaubey, B. B. *Vedic Concepts*,Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
16. Aggarwal, R. S. *Advance Objective General Knowledge*, S. Chand Publisher (2013)
17. Sen, S.*Concise General Knowledge Manual 2013,* Unique Publishers,2013
18. Verma, R. P.*Encyclopedia of General Knowledge and General Awareness* Penguin Books Ltd (2010)
19. Thorpe, E.; Thorpe, S.*General Knowledge Manual 2013-14,* The Pearson, Delhi.
20. Mohanty, M.*General Knowledge Manual 2013-14*, Macmillan Publishers India Ltd., Delhi.
21. *India 2013,* Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
22. Methew, M. *Manorama Year Book 2013-14,*Malayalam Manorama Publishers, Kottayam, 2013.
23. *Spectrum's Handbook of General Studies – 2013-14*, Spectrum Books (P) Ltd., New Delhi

CURRENT AFFAIRS

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum.
Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs, World Atlas Book

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune

Course Title: Group Theory I

L	T	P	Credits
5	1	0	6

Course Code: MTH 222

Course Objective: Group Theory is a mathematical concept which is used as a tool in almost all branches of science. The aim of this course is to make the students learn fundamental concepts of Groups.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: To recognize the mathematical objects called groups.
CO2: To understand the concept of Cyclic groups.
CO3: To learn cyclic notation for permutations and its types.
CO4: To explain the significance of the notions of cosets, normal subgroups, and factor groups.

UNIT-A **15 HOURS**

Symmetries of a square, definition and examples of groups including permutation groups, dihedral groups and quaternion groups (illustration through matrices), elementary properties of groups, Subgroups and examples of subgroups.

UNIT-B **15 HOURS**

Centralizer, normalizer, center of a group, product of two subgroups, properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group.

UNIT-C **15 HOURS**

Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

UNIT-D **15 HOURS**

Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Books Recommended

1. Bhattacharya, P.B., S.K. Jain, and S.R. Nagpal. *Basic Abstract Algebra*. New Delhi: Foundation Books. Print.

2. Herstein, I.N. *Topics in Algebra*, Wiley Eastern Limited, India, 1975. Print.
3. Fraleigh J.B. *A First Course in Abstract Algebra*, 7th Ed. Pearson, 2002**.** Print.
4. Gallian J.A. *Contemporary Abstract Algebra*, 4th Ed. New Delhi: Narosa Publishing House, 1999. Print.
5. Rotman J.J. *An Introduction to the Theory of Groups*, 4th Ed. Springer Verlag, 1995. Print.

Course Title: Real Analysis

L	T	P	Credits
5	1	0	6

Course Code: MTH 229

Course Objective: The aim of this course is to introduce the basic properties of the field of real numbers, concepts of limit and convergence (of real sequences, series) and to indicate how these are treated rigorously, and then show how these ideas are used in the development of real analysis.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Students will be able to demonstrate competence with the algebraic and order properties of real numbers and by finding supremum and infimum of sets.
CO2: Students will be able to demonstrate competence with the interior points, limit points and isolated points of sets. Students will learn about open and closed sets.
CO3: Students will be able to demonstrate competence with elementary properties of sequences by finding limits and proving results involving sum/difference/product/quotients of sequences and will be able to apply the monotone convergence theorem.
CO4: Students will be able to demonstrate competence with the convergence and divergence of positive terms series and alternative series using different tests of convergence.

UNIT-A **16 HOURS**

Review of Algebraic and Order Properties of, Idea of countable sets, uncountable sets and uncountability, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property , The Archimedean Property, Density of Rational (and Irrational) numbers . Characterization of intervals, Cantor Nested Interval Theorem.

UNIT-B **14 HOURS**

Sets in IR (Intervals): Neighborhood of a point. Properties of Neighbourhoods. Interior point. Open set. Union and Intersection of open sets. Limit point and isolated point of a set. Definition of derived set. Illustrations of Bolzano-Weierstrass theorem for sets. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of is both open & closed. Dense set in as a set having non-empty intersection with every open interval. Q and - Q are dense in.

UNIT-C **13 HOURS**

Sequences: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

UNIT-D **15 HOURS**

Infinite series: Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Books Recommended

1. Bartle, R.G. and D.R. Sherbert. *Introduction to Real Analysis,* 4th Ed. Singapore: John Wiley and Sons (Asia) Pvt. Ltd., 2002.
2. Rudin, W. *Principles of Mathematical Analysis, 3rd Edition*. New Delhi: McGraw-Hill Inc., 1976.
3. Berberian, S.K. *A First Course in Real Analysis*. New York: Springer Verlag, 1994.
4. Thomson, B.S., A.M. Bruckner and J.B. Bruckner. *Elementary Real Analysis.* Prentice Hall, 2001.
5. Apostol, Tom M., *Mathematical Analysis, 2nd Edition*, Pearson Education , 1974.

L	T	P	Credits
4	0	0	4

Course Title: Partial Differential Equations
Course Code: MTH 231

Course Objective: The objective of this course is to equip the students with knowledge of some advanced concepts related to differential equations and partial differential equations.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Observe basic concepts of partial differential equations related to degree, order with its classification as linear and nonlinear.
CO2: Discuss the solution of first and second order partial differential equations using various techniques.
CO3: Describe model of physical phenomena using partial differential equations such as the heat, wave and Laplace equations.
CO4: Analyze the fundamental and elementary solutions of boundary value problems.

UNIT-A **14 HOURS**

Partial Differential Equations– Basic concepts and definitions, Mathematical problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Lagrange's Method of Characteristics for obtaining General Solution of Quasi Linear Equations.

UNIT-B **12 HOURS**

Nonlinear equations of first order (four standard forms). Charpit method for finding complete integral of a non-linear PDE. Homogeneous linear equations with constant coefficients. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

UNIT-C **12 HOURS**

Derivation of Heat equation, Wave equation and Laplace equation, Classification of second order linear equations as hyperbolic, parabolic or elliptic, Reduction of second order Linear Equations to canonical forms.

UNIT-D **13 HOURS**

The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string, Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end, Equations with non-homogeneous boundary conditions, Non-Homogeneous Wave Equation. Method of separation of variables, solving the vibrating string problem, solving the heat conduction problem.

Books Recommended

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers,* 4th edition, Springer, Indian reprint, 2006.

2. Ross S.L., *Differential equations,* 3rd Ed., John Wiley and Sons, India, 2004.
3. Abell Martha L., and James P. Braselton, *Differential Equations with Mathematica,* 3rd edition. Elsevier Academic Press, 2004.
4. Singhania R., *Ordinary and Partial Differential Equations*. New Delhi: S. Chand and Company, 2006.
5. Kreyszig, Erwin, *Advanced Engineering Mathematics*. New Delhi: John Wiley & Sons, 1999.

L	T	P	Credits
0	0	4	2

Course Title: Partial Differential Equations Lab
Course Code: MTH 232

Course Objective: The aim of this course is to write Programs in MATLAB for the problems based on the methods studied in theory paper and to run the Program on PC.

List of Practical's (using any software)

1. Solving system of ODEs.
2. Solution of Cauchy problem for first order PDE.
3. Finding and plotting the characteristics for the first order PDE.
4. Plot the integral surfaces of a given first order PDE with initial data.
5. Solution of one dimensional heat equation.
6. Solution of wave equation with associated conditions.

Books Recommended

1. Pratap, R. Getting Started with MATLAB, Oxford University Press, New Delhi, 2015.
2. Chapman, S.J., MATLAB Programming for Engineers, 4th Edition, Cengage Learning, Boston, USA. 2015.
3. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
4. Ross S.L., Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
5. Abell Martha L., and James P. Braselton, Differential Equations with Mathematica, 3 rd edition.Elsevier Academic Press, 2004.
6. Singhania R., Ordinary and Partial Differential Equations. New Delhi: S. Chand and Company, 2006.
7. Kreyszig, Erwin, Advanced Engineering Mathematics. New Delhi: John Wiley & Sons, 1999.

Course Title: Theory of Real Functions

L	T	P	Credits
5	1	0	6

Course Code: MTH 221

Course Objective: The aim of this course is to introduce the concepts of limit, continuity, uniform continuity of a real function and to explore the concept of differentiation and study its applications.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Students will be able to demonstrate competence with the algebraic and order properties of real numbers and by finding supremum and infimum of sets.
CO2: Students will be able to demonstrate competence with the interior points, limit points and isolated points of sets. Students will learn about open and closed sets.
CO3: Students will be able to demonstrate competence with elementary properties of sequences by finding limits and proving results involving sum/difference/product/quotients of sequences and will be able to apply the monotone convergence theorem.
CO4: Students will be able to demonstrate competence with the convergence and divergence of positive terms series and alternative series using different tests of convergence.

UNIT-A **16 HOURS**

Limit of a function (epsilon-delta approach), sequential criterion for limits, divergence criteria, Limit theorems, one sided limits, Infinite limits and limits at infinity, Continuous functions, sequential criterion for continuity and discontinuity, Algebra of continuous functions, Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem.

UNIT-B **15 HOURS**

Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.
Differentiation: Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions, Relative extrema, interior extremum theorem, Inverse of Strictly Monotone Functions.

UNIT-C **15 HOURS**

Rolle's Theorem, Mean value theorem, First derivative test for extrema, intermediate value property of derivatives, Darboux's theorem, Applications of mean value theorem to inequalities and approximation of polynomials, Cauchy's mean value theorem, L'Hospital's Rules.

UNIT-D **13 HOURS**

Taylor's theorem and its application to inequalities, Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema, Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions.

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Books Recommended

1. Bartle, R.G. and D.R. Sherbert. *Introduction to Real Analysis,* 3rd Ed. Singapore: John Wiley and Sons (Asia) Pvt. Ltd., 2002.
2. Apostol, T. M. *Mathematical Analysis*, 2nd Edition, Narosa Publishing House, Reprint 2002.
3. Ross K. A., *Elementary Analysis: The Theory of Calculus*. Springer, 2004.
4. Mattuck A., *Introduction to Analysis*. Prentice Hall, 1999.
5. Ghorpade S.R. and B.V. Limaye, *A Course in Calculus and Real Analysis.* Springer, 2006.
6. Malik, S. C. and Savita Arora. *Mathematical Analysis*, 3rd Edition. New Age International Publishers, 2008.

Course Title: Numerical Methods

L	T	P	Credits
4	0	0	4

Course Code: MTH 225A

Course Objective: The aim of this course is to teach the applications of various numerical techniques for a variety of problems occurring in daily life. At the end of the course, the students will be able to understand the basic concepts in Numerical Analysis of differential equations.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn solution of Algebraic and transcendental equations.
CO2: Learn solution of system of linear equations with different approximation and direct methods.
CO3: Understand operators and relations between different operators, interpolation and different methods of using interpolations.
CO4: Understand numerical differentiation and integrations and various methods to solve these problems.

UNIT-A **15 HOURS**

Approximate numbers, Significant figures, rounding off numbers, Inherent errors, Rounding errors, Truncation errors, Absolute, Relative and Percentage error.

Non-Linear Equations: Transcendental and Polynomial equations. Bisection method, Secant method, Regula-Falsi method, Newton Raphson method, Order of convergence of these methods

UNIT-B **14 HOURS**

System of linear algebraic equations: Matrix inversion method, Gauss Elimination method, Gauss Jordan method and its application to find inverse of a square matrix , Decomposition Method, Jacobi method, Gauss Seidel method, Partial and Complete pivoting, ill conditioned systems.

UNIT-C **13 HOURS**

Operators: Forward, Backward, Shift and divided difference operators (Definitions and relations among them).
Newton's forward and backward difference
interpolation. Newton's divided difference formula, Lagrange's interpolation, Inverse Interpolation, Gauss Interpolation

UNIT-D **14 HOURS**

Numerical Integration: Newton Cote's integration formula, Trapezoidal, Simpson 1/ 3 and 3/8 rule. (Order of Error in each case)
Numerical solutions to first order ordinary differential equations: Picard method of successive approximations, Taylor series method**,** Euler's method, Modified-Euler's method, Runge-Kutta methods.

Books Recommended

1. Shastry, S. S. *Introductory Methods of Numerical Analysis*. New Delhi: PHI Learning Private Limited, 2005.
2. Jain, M.K., Iyenger, S. R. K. and R. K. Jain. *Numerical Methods for Scientific and Engineering Computation.* Delhi: New Age International Publishers, 2012.
3. Gerald C. F., and P. O. Wheatley. *Applied Numerical Analysis.* India: Pearson Education, 2008.
4. Mathews, John H., and D. Fink Kurtis. *Numerical Methods using Matlab 4th Edition.* New Delhi: PHI Learning Private Limited, 2012.
5. Grewal B. S. *Numerical Methods in Engineering and Science.* New Delhi: Khanna Publishers, 2014

L	T	P	Credits
0	0	4	2

Course Title: Numerical Methods Lab
Course Code: MTH 226

Course Objective: The aim of this course is to teach the applications of various numerical techniques for a variety of problems occurring in daily life. At the end of the course, the students will be able to understand the basic concepts in Numerical Analysis of differential equations.

List of Practicals (using any programming software)

1. Introduction to MATLAB.
2. Averaging of numbers.
3. Magnitude of a vector.
4. Sum of Sine/Cosine series.
5. Sorting of numbers.
6. Bisection Method.
7. Secant Method.
8. Regula Falsi Method.
9. Gauss-Elimination
10. Newton Interpolation.
11. Lagrange interpolation.
12. Trapezoidal rule.
13. Simpson's $1/3^{rd}$ and $3/8^{th}$ rule.
14. Euler's method.

Books Recommended

1. Shastry, S.S. *Introductory Methods of Numerical Analysis.* New Delhi: PHI Learning Private Limited, 2005. Print.
2. Iyenger, S.R.K., R.K. Jain, and Mahinder Kumar. *Numerical Methods for Scientific and Engineering Computation.* Delhi: New Age International Publishers, 2012. Print.
3. Gerald C.F., and P.O. Wheatley. *Applied Numerical Analysis.* India: Pearson Education, 2008. Print.
4. Mathews, John H., and D. Fink Kurtis. *Numerical Methods using Matlab*, 4th Ed. New Delhi: PHI Learning Private Limited, 2012. Print.
5. Grewal B.S. *Numerical Methods in Engineering and Science.* New Delhi: Khanna Publishers, 2014. Print.

L	T	P	Credits
5	1	0	6

Course Title: Analytical Geometry
Course Code: MTH 234

Course Objective: The course is an introductory course on Analytical Geometry so as to provide basic understanding of the geometry of two and three dimensions.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand basic understanding of the geometry of two dimensions, fundamental concepts of pair of straight lines in 2D, Circle and co-axial family of circle.
CO2: Understand fundamental concepts and properties of conics (parabola, ellipse and hyperbola).
CO3: Understand basic understanding of the geometry of three dimensions, fundamental concepts of straight lines in 3D, Sphere and related important notions.
CO4: Understand the fundamental concepts of Cone, cylinder and conicoids.

UNIT-A **14 HOURS**

Preliminary- Cartesian co-ordinates, polar co-ordinates and their transformations, straight line in , positive and negative side of a line, bisectors of angles; Change of Axes- Translation and rotation of axes, general transformation, invariants; Pair of Straight lines- Homogeneous equation of second degree, angle between pair of straight lines, joint equation of the angle bisectors, joint equation of lines joining origin to the intersection of a line and a curve; Circle: General equation of circle, tangents and normal, pair of tangents from a given point, chord of contact, pole and polar, equation of chord in terms of mid-point, angle of intersection and orthogonality of two circles, radical axis, coaxial family of circles.

UNIT-B **14 HOURS**

Conics- Standard equations of conics (parabola, ellipse, hyperbola), tangent and normal, tangents from a point, chord of contact, pole and polar, equation of chord in terms of midpoint, diameter, conjugate diameters of ellipse and hyperbola, special properties of parabola, ellipse and hyperbola, asymptotes of a hyperbola, conjugate hyperbola, , rectangular hyperbola; Tracing of conics- The second degree equation , reduction of the second degree equation into standard form, principal axes and eccentricity of a conic, identification of curves represented by (including pair of lines); Polar equation of a conic- Polar equations of straight lines, circles and conics, polar equation of chords, tangents and normal, director circle.

UNIT-C **14 HOURS**

The plane- Equation of a plane and its different forms, system, two sides of a plane, bisector of angles between two planes, joint equation of two planes, distance of a point from a plane; The line- Equation of line in and its symmetrical & unsymmetrical forms, angle between line and a plane, conditions for a line to lie in a plane, co-planarity of lines, shortest distance between two lines, length of perpendicular from a point to a line; Sphere- Equation of a sphere and its properties, the tangent plane, plane of contact, the polar plane, angle of intersection of two spheres.

UNIT-D **14 HOURS**

Cone and Cylinder- Equation of a cone, enveloping cone of sphere, intersection of cone with a line, right circular cone, equation of cylinder, enveloping cylinder, right circular cylinder; Conicoids- General equation of the second degree in three variables, equations of central conicoids (the ellipsoid, hyperboloid of one and two sheets), intersection of line with a conicoid, director sphere, normal from a given point, elliptic and hyperbolic paraboloid.

Books Recommended:

1. Jain, P.K., and A. Khalil, *A textbook of Analytical Geometry*. New Age International Publishers, Edition 3rd, New Delhi, 2014.

2. Narayan, S. and P.K. Mittal, *Analytical Solid Geometry.* S. Chand & Company Pvt. Ltd., New Delhi, 2008.

Course Title: Mechanics I

L	T	P	Credits
5	1	0	6

Course Code: MTH 341

Course Objective: The objective of this paper is to make students understand the concepts and basics of Mechanics and to clarify the foundations of Statics. The students will be made familiar about the forces and their consequences when acting on bodies, the forces being so arranged that the bodies remain at rest. One Unit has also been devoted to center of gravity and friction.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand basic understanding of the geometry of two dimensions, fundamental concepts of pair of straight lines in 2D, Circle and co-axial family of circle.
CO2: Understand fundamental concepts and properties of conics (parabola, ellipse and hyperbola).
CO3: Understand basic understanding of the geometry of three dimensions, fundamental concepts of straight lines in 3D, Sphere and related important notions.
CO4: Understand the fundamental concepts of Cone, cylinder and conicoids.

UNIT-A **14 HOURS**

Preliminary concepts; Force and System of forces - parallel, coplanar, collinear, concurrent, equivalent; Composition and Resolution of forces- parallelogram law, resolved part of a force, triangle law, theorem, Lami's theorem; Polygon law, resultant of number of coplanar concurrent forces and their equilibrium conditions; Parallel forces.

UNIT-B **14 HOURS**

Moments- definition, sign conventions, geometrical representation, Varignon's theorem, resultant of number of coplanar forces, generalized theorem of moments, moment about a line; Couples- definition, zero couple, moment of a couple, equilibrium of two couples, resultant of coplanar couples, resultant of a force and a couple, triangle theorem of moments, conditions for a system of coplanar forces to reduce to a single force or a single couple.

UNIT C **14 HOURS**

Equilibrium of a rigid body acted on by three coplanar forces, theorem; General conditions of equilibrium of a body acted upon by coplanar forces; Virtual work- Definition, principle of virtual work and related problems.

UNIT D **14 HOURS**

Centre of Gravity (C.G.)-definition and concept, C.G. of different rigid bodies via uniform rod, laminas with specific geometrical shapes, tetrahedron, cone, hemisphere etc.; Friction- definition and nature of friction, types and laws of friction, angle of friction, coefficient of friction, and equilibrium of a particle on a rough inclined plane.

Books Recommended

1. S.L. Loney, *The elements of statics and dynamics*, 5th edition, Cambridge University Press, 1947.

2. Nelson E.W., Best C.L. and Mclean W.G., *Schaum's outline of theory and problems of engineering mechanics-statics and dynamics*, 5th edition, Mc Graw Hill Book Company, New Delhi, 1997.

Course Title: Riemann Integration and Series of Functions

L	T	P	Credits
5	1	0	6

Course Code: MTH 345

Course Objective: The aim of this course is to introduce Riemann Integration, Improper Integrals, Uniform Convergence and Power Series.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand the fundamental concept of Riemann integration and theorems on integrability.
CO2: Solve problems on convergence of improper integrals and understand the relationship between Beta and Gamma function.
CO3: Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability and integrability.
CO4: Understand and represent functions as power series.

UNIT-A **15 HOURS**

Riemann integration: inequalities of upper and lower sums, Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two definitions, Riemann integrability of monotone and continuous functions, The Class of Riemann integrable functions.

UNIT-B **15 HOURS**

Properties of the Riemann integral, definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals, Fundamental theorems of Calculus.

Improper Integrals: General Value and Cauchy value, type-I. type-II and mixed integrals, Convergence of Beta and Gamma Functions, Properties of Beta Function. Recurrence Formula for Gamma Function, Relation between Beta and Gamma Functions, Duplication Formula.

UNIT-C **14 HOURS**

Pointwise and Uniform convergence of sequence of functions. Weierstrass M-Test, Uniform Convergence and Continuity, Uniform convergence and Integration, Uniform convergence and differentiation, A Continuous nowhere differentiable function, Weierstrass Approximation Theorem.

UNIT-D **16 HOURS**

Power series, Radius of convergence, Cauchy Hadamard Theorem, Differentiation and Integration of Power Series, Abel's Theorem, Multiplication of Two Series, Exponential, Logarithmic and Trigonometric functions.

Books Recommended

1. Ross, K.A. *Elementary Analysis, The Theory of Calculus*. Undergraduate Texts in Mathematics, Indian reprint: Springer (SIE), 2004. Print.
2. Bartle, R.G., and D.R. Sherbert. *Introduction to Real Analysis.* 3rd Ed., Singapore: John Wiley and Sons (Asia) Pvt. Ltd., 2002. Singapore
3. Denlinger, Charles G. *Elements of Real Analysis*.Massachusetts: Jones & Bartlett (Student Edition), 2011. Print.
4. Malik, S. C. and Savita Arora. *Mathematical Analysis,* 3rd Edition. New Age International Publishers, 2008.

L	T	P	Credits
5	1	0	6

Course Title: Number Theory
Course Code: MTH 324

Course Objective: The objective is for the students to obtain a foundational knowledge of elements of Number Theory through step-by-step proofs of classical theorems, as well as to sharpen their skills through problem-solving. The material of the course will be such that one can be initiated to the subject gradually and thus future study will be made more natural.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Linear Diophantine equation and its solutions, Fermat's and Wilson's and Chinese Remainder theorem and Linear Congruences.
CO2: Numeric functions, Dirichlet product, Mobius Inversion formula and Greatest Integer functions.
CO3: Euler's phi-function and its properties, Integer modulo n, Euler's criterion, Legendre symbol and its properties and quadratic reciprocity.
CO4: Quadratic Congruences with composite moduli, Fermat's Last theorem.

UNIT-A **15 HOURS**

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

UNIT-B **15 HOURS**

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function.

UNIT-C **15 HOURS**

Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function. Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity.

UNIT D **15 HOURS**

Quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

Books Recommended

1. Burton, David M. *Elementary Number Theory,* 7th Ed., Delhi: Tata McGraw-Hill, 2007. Print.
2. Robinns, Neville. *Beginning Number Theory,* 2nd Ed., Delhi: Narosa Publishing House Pvt. Ltd., Delhi, 2007. Print.
3. Jones, G.A., and J.M. Jones. *Elementary Number Theory,* Springer, 1998, Print.

L	T	P	Credits
5	1	0	6

Course Title: Discrete Mathematics
Course Code: MTH 327

Course Objective: The objective of this course is to acquaint the students with the basic concepts in Discrete Mathematics and Graph Theory. It also includes the topic like Mathematical Logic, Recursive relations and Boolean algebra.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn fundamental of logics, truth tables, quantifiers and counting techniques.
CO2: Learn Pigeonhole principle, solution of recurrence relations and generating functions.
CO3: Learn graph theory, Handshaking theorem, Planar and Non-planar graph.
CO4: Learn Boolean Algebra, Logic Gates and Lattice theory.

UNIT-A **15 HOURS**

Set Theory, Relations and Functions: Natural Numbers- Well Ordering Principle, Principle of Mathematical Induction, Sets, Algebra of Sets, Ordered Sets, Subsets, Relations, Equivalence Relations and Partitions, Hasse diagram, Lattices, Functions, Special functions, Composition of Functions, one-one, onto and Inverse of a function, Number of one-one functions.

UNIT-B **15 HOURS**

Basic Counting Principles and Recurrence Relations: Permutation, Combinations, Pigeonhole Principle, Inclusion-exclusion Principle, Number of onto functions, Partitions, Recurrence Relations, Characteristic Equation, Homogeneous and non-homogeneous linear recurrence relations with constant coefficients, Generating Functions for some standard sequences.

UNIT-C **15 HOURS**

Graphs and Trees: Basic Terminology, Special Graphs, Handshaking Theorem, Isomorphism of Graphs, Walks, Paths, Circuits, Eulerian and Hamiltonian Paths, Planar and Non Planar Graphs, Coloring of Graph, Directed graphs, Travelling Salesman Problem, Binary Trees, Tree Traversing: Preorder, Post-order and In-order Traversals, Minimum Spanning Trees, Shortest path problems, Prim's and Kruskal's Algorithm.

UNIT-D **15 HOURS**

Logic and Boolean algebra: Propositions, Basic logic operators, Logic equivalence involving Tautologies and Contradiction, Conditional Propositions, Quantifiers, Introduction to Boolean algebra, laws of Boolean algebra, Boolean function, Sum of product form, K-map, logic gates and circuits.

Books Recommended

1. Rosen, K. H. *Discrete Mathematics and its Applications*, 6th Edition, McGraw Hill, 2007. Print.
2. Malik, D.S., and M.K. Sen. *Discrete Mathematical Structures: Theory and Applications*, New Delhi: Thomson Cengagae Learning, 2004. Print.
3. Lipschutz, S. and M. L. Lipson. *Schaum's Outline of Discrete Mathematics*. New Delhi: Schaum's Outlines, 2007. Print.
4. Ram, B. *Discrete Mathematics*. Pearson Publications, 2011. Print.
5. Liu, C. L., *Elements of Discrete Mathematics***.** McGraw Hill, International Edition, Computer Science Series.1986. Print.
6. Trembley, J.P. and R.P. Manohar. *Discrete Mathematical Structures with Applications to Computer Science*. McGraw Hill, 1975. Print.
7. Joshi, K.D., *Foundations of Discrete Mathematics,* New Age International Pvt Limited, 2014.

L	T	P	Credits
5	1	0	6

Course Title: Industrial Mathematics
Course Code: MTH 326

Course Objective: Industrial Mathematics is to enable students to acquire the fundamentals of applied mathematics in areas of classical and numerical analysis, differential equations and dynamical systems, and probability and statistics.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn the basics of mathematics in medical imaging and importance of inverse problems.
CO2: Understand the fundamental concepts of X- ray and tomography.
CO3: Understand the fundamental concepts of Radon transformation and Back projection and its properties.
CO4: Learn the basics of Fourier series, its applications and algorithms related to CT scan.

UNIT-A **15 HOURS**

Medical Imaging and Inverse Problems. The content X-Ray is based on Mathematics of complex numbers and matrices and CT scan based on the knowledge of equations.
Introduction to Inverse problems: Why should we teach Inverse Problems? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations.

UNIT-B **15 HOURS**

Geological anomalies in Earth's interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.
X-ray: Introduction, X-ray behavior and Beers Law (The fundament question of image construction) Lines in the place.

UNIT-C **15 HOURS**

Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms).
Back Projection: Definition, properties and examples.

UNIT-D **15 HOURS**

CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

Books Recommended

1. Feeman, Timothy G. *The Mathematics of Medical Imaging. A Beginners Guide*, Springer Under graduate Text in Mathematics and Technology, Springer, 2010. Print.
2. Groetsch, C.W. *Inverse Problems*. Activities for Undergraduates, The Mathematical Association of America, 1999. Print.
3. Kirsch, Andreas. *An Introduction to the Mathematical Theory of Inverse Problems* 2nd Ed. Springer, 2011. Print.

L	T	P	Credits
5	1	0	6

Course Title: Group Theory II
Course Code: MTH 322

Course Objective: The objective of this course is to understand the structure of finite groups and some properties of finite groups.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand Automorphism group in both finite and infinite cyclic groups. Understanding characteristics subgroup, commutator subgroup with their properties.
CO2: Understand the structure of finite groups and some properties of finite groups and properties of U(n).
CO3: Understand group actions, related notion and application of group actions.
CO4: Understand the fundamental concepts of sylow p-subgroups, sylow theorems and their application in non-simplicity of groups.

UNIT-A **15 HOURS**

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

UNIT-B **15 HOURS**

Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

UNIT-C **15 HOURS**

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.

UNIT-D **15 HOURS**

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, *p*-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for $n \geq 5$, non-simplicity tests.

Books Recommended

1. Bhattacharya, P.B., S.K. Jain, and S.R. Nagpal. *Basic Abstract Algebra*. UK: Cambridge University Press, 2006, Print.
2. Fraleigh, John B. *A First Course in Abstract Algebra*. 7th Ed., India: Pearson, 2002**.** Print.

3. Gallian, Joseph A. *Contemporary Abstract Algebra.* 4th Ed., Delhi: Narosa Publishing House, 1999.
4. Dummit, David S., and Richard M. Foote. *Abstract Algebra*. 3rd Ed., Singapore: John Wiley and Sons (Asia) Pvt. Ltd., 2004. Print.
5. Rotman Joseph J. *An Introduction to the Theory of Groups,* 4th Ed. Springer Verlag, 1995. Print.

L	T	P	Credits
5	1	0	6

Course Title: Probability and Statistics
Course Code: MTH 328

Course Objective: The course is designed to develop greater skill and understanding of statistics and probability and to explore properties of probability distributions.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn Probability axioms, Random variables, PMF and PDF, Mathematical Expectation, MGF.
CO2: Learn Joint distribution & joint probability function and their properties, Conditional expectations, Correlation and joint moment generating function.
CO3: Learn Discrete distribution : Uniform, Binomial, Poisson, Geometric, Negative binomial. Continuous Distributions: Uniform, Normal, Exponential.
CO4: Learn Partial Correlation and multiple correlations, Karl Pearson Co-efficient of correlation, Rank Correlation, Regression Coefficient and their properties, curvilinear regression.

UNIT-A **14 HOURS**

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function.

UNIT-B **15 HOURS**

Joint distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, correlation coefficient, joint moment generating function (jmgf).

UNIT-C **14 HOURS**

Discrete distributions: uniform, binomial, Poisson, geometric, negative binomial. Continuous distributions: uniform, normal, exponential.

UNIT-D **16 HOURS**

Correlation: Partial correlation and multiple correlation, Scatter Diagram, Karl Pearson coefficient of correlation, Rank Correlation. Linear regression, Regression coefficients and their properties, angle between two lines of regression, Curvilinear regression.

Books Recommended

1. Gupta, S.C., and V.K. Kapoor. *Fundamentals of Mathematical Statistics*. New Delhi: S. Chand & Sons, 2002. Print.

2. Mood, A.M., F.A. Graybill, and D.C., Boes. *Introduction to the theory of Statistics*. Delhi: McGraw Hill, 1974. Print.

3. Hogg, Robert V., Joeseph McKean and Allen T Craig. *Introduction to Mathematical Statistics.* London : Pearson Education Limited, 2014. Print.

4. Baisnab, A. P., and M. Jas. *Elements of Probability and statistics*. Delhi: Tata McGraw Hill, 2004. Print.

5. Meyer, P.L., *Introductory Probability and Statistical Applications.* Delhi: Addison-Wesley Publishing Company, 1970. Print.

6. Ross, Sheldon. *Introduction to Probability Models,* 9th Ed., Academic Press, Indian Reprint, 2007. Print.

L	T	P	Credits
5	1	0	6

Course Title: Multivariate Calculus
Course Code: MTH 321

Course Objective: This course includes the study of multivariable calculus; including partial derivatives, multiple integrals, and their applications; parametric curves and surfaces in 3-space; solid analytic geometry; and the calculus of vector-valued functions, including line integrals and flux integrals.
Use of Scientific calculator is allowed.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand basic concepts of limits, continuity, partial derivatives and applications of multivariate functions.
CO2: Get in depth Knowledge of techniques for the evaluation of extreme value of multivariate functions.
CO3: Learn various applications of double and triple integrals.
CO4: Understand basics of vector calculus and its applications in interdisciplinary fields.

UNIT-A **16 HOURS**

Functions of several variables, limit and continuity of functions of two variables. Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability, symmetry of mixed partial derivatives. Chain rule for one and two independent parameters, partial derivatives with constrained variables.

UNIT-B **14 HOURS**

Directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes and normal lines. Extreme values and saddle points: Extrema of functions of two variables, method of

Lagrange multipliers, constrained optimization problems.
Banach Contraction principle, Inverse function theorem and implicit function theorem.

UNIT-C **15 HOURS**

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals.

UNIT-D **15 HOURS**

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.
Definition of vector field, divergence and curl. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Books Recommended

1. Thomas, G.B. and R.L. Finney. *Calculus*. 9th Ed., Delhi: Pearson Education, 2005. Print.
2. Strauss, M.J., G.L. Bradley, and K. J. Smith. *Calculus.* 3rd Ed., Delhi: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2007. Print.
3. Anton, H., I. Bivens, and S. Davis. *Calculus Multivariable*. 9th Ed., Singapore: John Wiley and Sons (Asia) P. Ltd., 2009. Print.
4. Marsden, E., A.J. Tromba, and A. Weinstein. *Basic Multivariable Calculus*. Indian reprint: Springer (SIE), 2005. Print.
5. Stewart, James. *Multivariable Calculus, Concepts and Contexts*. 2nd Ed., USA: Brooks /Cole, Thomson Learning, 2001. Print.

L	T	P	Credits
5	1	0	6

Course Title: Mechanics II
Course Code: MTH 344

Course Objective: The objective of this paper is to get acquainted the students about the different mathematical concepts and laws during the motion of bodies under the action of forces.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT-A **14 HOURS**

Basis definitions and preliminary concepts; Motion in a straight line with constant acceleration, velocity-time curve; Vertical motion under gravity; Newton's laws of motion, absolute and gravitational units of force, concept of weight and mass, motion on a smooth inclined plane; Relative motion.

UNIT-B **14 HOURS**

Applications of laws of motion- motion of two particles connected by a string passing over a smooth pulley considering different situations *via* two particles hanging freely, one particle being placed on a smooth table and the other hanging freely, one particle being placed on a smooth inclined plane, both particles being placed on two equally rough inclined planes placed back to back etc., weight carried by a lift; Motion under variable acceleration; Simple harmonic motion- center of attraction, mean position, extreme positions; SHM as a periodic motion, time period and frequency.

UNIT-C **14 HOURS**

Projectile motion in a vertical plane under gravity - equation of trajectory, range, time of flight, greatest height achieved and related problems; Projectile on an inclined plane; Curvilinear motion of particle- expressions of velocity and acceleration in Rectangular components, in tangential and normal components, in radial and transverse components; motion along a smooth circle as special case.

UNIT-D **14 HOURS**

Angular velocity and angular acceleration, Centripetal and centrifugal forces, Central force motion-areal velocity and angular momentum, differential equation of central orbit, law of force, Kepler's laws of planetary motion; Work, power and energy- absolute and gravitational units of work and power, kinetic and potential energy, principle of work and energy, principle of conservation of energy.

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Books Recommended

1. S.L. Loney, *The elements of statics and dynamics*, 5th edition, Cambridge University Press, 1947.
2. Nelson E.W., Best C.L. and Mclean W.G., *Schaum's outline of theory and problems of engineering mechanics-statics and dynamics*, 5th edition, Mc Graw Hill Book Company, New Delhi, 1997.
3. Synge, J. L., Griffth, B. A., *Principles of mechanics*, 2nd edition, Mc-Graw Hill Book Comapny, 1947.
4. Chorlton, F.,*Text book of Dynamics*. CBS Publishers, Reprint 2002.

L	T	P	Credits
5	1	0	6

Course Title: Metric Spaces and Complex Analysis
Course Code: MTH 343

Course Objective: The aim of this course is to introduce the theory of metric and the theory of analytic functions. The aim is to show how the theory and concepts grow naturally from problems and examples.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: The concept of metric spaces and their properties, Cantor intersection theorem, dense sets and separable sets.
CO2: The concept of compact sets, Heine Borel theorem, Bolzano Weierstrass Property, finite intersection property, etc.
CO3: Axiomatic approach to complex numbers, stereographic projection, trigonometric and hyperbolic functions.
CO4: The concept of limit and continuity, differentiability, Cauchy=Riemann equations, analytic functions, harmonic functions and analyticity at infinity.

UNIT-A **15 HOURS**

Metric spaces: definition and examples, balls and bounded sets. Sequences in metric spaces, convergent and Cauchy sequences. Complete Metric Spaces. Open and closed sets: neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor intersection theorem. Subspaces, dense sets, separable spaces, totally bounded sets.

UNIT-B **15 HOURS**

Compact sets, Heine Borel theorem, sequential compactness, Bolzano Weierstrass property, finite intersection property, continuity and compactness, uniform continuity, Dense sets, separable sets.

UNIT-C **15 HOURS**

Axiomatic approach to complex numbers, Complex plane, Polar form of complex numbers, Stereographic projection, Simply Connected regions, Branches of multi-valued functions, Principle Logarithm, complex exponents, Trigonometric and Hyperbolic Functions.

UNIT-D **15 HOURS**

Limit, Continuity, Differentiability of a complex function, Cauchy-Riemann equations, sufficient conditions for differentiability, Differentiation of Elementary functions, Analytic functions, Harmonic functions and their Conjugates, Analyticity at Infinity.

Books Recommended

1. Jain, P. K. Jain and Khalil Ahmad. *Metric Spaces,* Alpha Science International, 2nd Revised Edition, 2004
2. Copson, E.T. *Metric Spaces,* London: Cambridge University Press, 1988. Print.
3. Copson, E.T. *Theory of the function of the complex variable*, London: Oxford Clarendon Press, 1970, Print.
4. Zill, G. Dennis., and Patrick. D. Shanahan. Complex Analysis: A first Course with Applications: Burlington: Jones & Bartlett Learning, 2015. Print.
5. Brown, J. W. and R. V. Churchill. *Complex Variables and Applications,* 8th Ed. Delhi: McGraw Hill International Edition, 2009. Print
6. Bak, Joseph and D. J. Newman. *Complex Analysis*, 2nd Ed. *Undergraduate Texts in Mathematics*. New York: Springer-Verlag New York, Inc, 1997. Print.

L	T	P	Credits
5	1	0	6

Course Title: Bio-Mathematics
Course Code: MTH 332

Course Objective: Biomathematics is contributing both in its basic research and the development of specialized computer software to support investigation and healthcare.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn Mathematical Biology and the modeling process, Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model.
CO2: Learn Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.
CO3: Spatial Models: One species model with diffusion, two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, travelling wave solutions, spread of genes in a population.
CO4: Learn Discrete Models, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host- Parasitoid systems (N icholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

UNIT-A **15 HOURS**

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation.

UNIT-B **15 HOURS**

Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.

UNIT-C **15 HOURS**

Spatial Models: One species model with diffusion, two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, travelling wave solutions, spread of genes in a population.

UNIT-D **15 HOURS**

Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

Books Recommended

1. Keshet, L.E. *Mathematical Models in Biology*. SIAM, 1988.Prinnt.
2. Murray, J. D. *Mathematical Biology*. Springer, 1993.Print.
3. Fung, Y.C. *Biomechanics*. Springer-Verlag, 1990.Print.
4. Brauer, F., P.V.D. Driessche, and J. Wu. *Mathematical Epidemiology*. Springer, 2008. Print.
5. Kot, M. *Elements of Mathematical Ecology*. Cambridge University Press, 2001.Print.

L	T	P	Credits
5	1	0	6

Course Title: Linear Programming
Course Code: MTH 333

Course Objective: The aim of this course is setting up optimization models from problem description and solving linear programming problems using the simplex method. The role of duality for linear programming problems is examined.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand the key concepts of Operational Research and Linear Programming and their role in various organizations.
CO2: Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method, demonstrate the solution process by hand and solver.
CO3: Employ the suitable methods for improving transportation cost of transportation problems.
CO4: Understand solution procedure and different mixed strategies of games.

UNIT-A **16 HOURS**

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables. Two-phase method, Big-M method and their comparison.

UNIT-B **14 HOURS**

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.Theorem of Weak duality, strong duality, Basic duality theorem, Weak complementary slackness theorem, Strong complementary slackness theorem, their applications, Application of Duality to Farkas' lemma and solutions of linear inequalities.

UNIT-C **15 HOURS**

Transportation problem and its mathematical formulation, Northwest-corner method, Least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

UNIT-D **14 HOURS**

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, and linear programming solution of games.

Books Recommended

1. Bazaraa,Mokhtar S, John J. Jarvis and Hanif D. Sherali. *Linear Programming and Network Flows,* India: John Wiley and Sons, 2004. Print.
2. Hillier, F.S. and G.J. Lieberman. *Introduction to Operations Research,* Singapore: Tata McGraw Hill, 2009.Print.
3. Taha, Hamdy A. *Operations Research, An Introduction,* India: Prentice-Hall, 2006.Print.
4. Hadley,G. *Linear Programming,* New Delhi: Narosa Publishing House , 2002.Print.

L	T	P	Credits
5	1	0	6

Course Title: Mathematical Modeling
Course Code: MTH 334

Course Objective: The objective of the course is to introduce mathematical modelling, that is, the construction and analysis of mathematical models inspired by real life problems. The course will present several modelling techniques and the means to analyze the resulting systems.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn power series, ordinary point and regular singular point, Bessel's and Legendre's equation, their recurrence . Recurrence relations and generating functions.
CO2: Learn Laplace and inverse transforms, Application of Laplace and inverse for solving initial value problem upto second order.
CO3: Learn Monte Carlo Simulation Modeling, Generating random numbers.
CO4: Learn Queuing Models and Linear Programming Model.

UNIT-A **15 HOURS**

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's and Legendre's equations, orthogonal properties & recurrences relation, Generating Function.

UNIT-B **15 HOURS**

Laplace transform and inverse transform, application to initial value problem up to second order.

UNIT-C **15 HOURS**

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence.

UNIT-D **15 HOURS**

Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution, algebraic solution, simplex method, sensitivity analysis

Books Recommended

1. Tyn Myint, U, and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*. Indian: Springer, 2006.

2. Giordano Frank R., Maurice D. Weir, and William P. Fox, *A First Course in Mathematical Modeling*. London and New York: Thomson Learning, 2003.

3. Kapur, J.N, *Mathematical Modelling*, New Age International (P) limited, New Delhi: 2005.

L	T	P	Credits
5	1	0	6

Course Title: Ring Theory and Linear Algebra I
Course Code: MTH 347

Course Objective: The main objective is to introduce basic notions in linear algebra and ring theory that are often used in mathematics, importantly in abstract algebra.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn about rings, subrings, factor ring, integral domain, ideals, prime ideals and maximal ideals.
CO2: Learn about ring homomorphism, properties of ring homomorphism, Isomorphism theorems, Field of quotients.
CO3: Vector spaces, subspaces, basis and dimension, Linear combination of vectors, Linear span, L.D. and L.I.
CO4: Linear transformation, rank and nullity, Isomorphism theorems.

UNIT-A **15 HOURS**

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals,

prime and maximal ideals.

UNIT-B **15 HOURS**

Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III. Field of quotients.

UNIT-C **15 HOURS**

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

UNIT-D **15 HOURS**

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphism, Isomorphism theorems, invertibility and change of coordinate matrix.

Books Recommended

1. Bhattacharya, P.B., S.K.Jain, and S.R.Nagpal. *Basic Abstract Algebra, 2nd edition.* U.K: Cambridge University Press, 2004.
2. Hoffman, Kenneth, and Ray Alden Kunze. *Linear Algebra, 2nd edition.* Prentice-Hall of India Pvt. Ltd., 1971.
3. Fraleigh, John B. *A First Course in Abstract Algebra*, 7th *edition*. Pearson, 2002.
4. Artin, M. *Abstract Algebra*, *2nd Ed.,* Pearson, 2011.
5. Gallian, Joseph A. *Contemporary Abstract Algebra*, *4th Ed.,* Narosa Publishing House, 1999.
6. Lang, S. I*ntroduction to Linear Algebra, 2nd Ed.,* Springer, 2005.
7. Strang, Gilbert. *Linear Algebra and its Applications*, Thomson, 2007.

L	T	P	Credits
5	1	0	6

Course Title: Differential Geometry
Course Code: MTH 336

Course Objective: To introduce students to Differential Geometry. Surfaces; the shape operator; principal, Gaussian and mean curvatures; minimal surfaces; geodesics.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand differential geometry of plane curves and space curves.
CO2: Understand the orientability of surfaces.
CO3: Understand geometrical interpretation of first fundamental form, second fundamental form and principal Curvature.
CO4: Understand geodesic curves and related notions.

UNIT-A **15 HOURS**

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

UNIT-B **15 HOURS**

Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

UNIT-C **15 HOURS**

Developables: Developable associated with space curves and curves on surfaces, Minimal surfaces.

UNIT-D **15 HOURS**

Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor

form, Physical components.

Books Recommended

1. Willmore, T.J. *An Introduction to Differential Geometry*. Dover Publications, 2012.
2. O'Neill B., *Elementary Differential Geometry*, 2nd edition. Academic Press, 2006.
3. Weatherburn C.E., *Differential Geometry of Three Dimensions*. Cambridge: Cambridge University Press, 2003.
4. Struik D.J., *Lectures on Classical Differential Geometry*. Dover Publications, 1988.
5. Lang S., *Fundamentals of Differential Geometry*. Springer, 1999.
6. Spain B., *Tensor Calculus: A Concise Course*. Dover Publications, 2003.

L	T	P	Credits
5	1	0	6

Course Title: Finite Element Methods
Course Code: MTH 140

Course Objective: The objective of this course is to learn basic principles of finite element analysis procedure.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Introduction to finite element methods, solve boundary value problems and ordinary differential equation using Galerkin method, Ritz method.
CO2: To solve assembled system, linear, quadratic and higher order elements in one dimensional
CO3: Learn about Simplex elements in two and three dimensions, quadratic triangular elements, rectangular elements, serendipity elements and isoperimetric elements Discretization with curved boundaries.
CO4: Interpolation functions, numerical integration, and modeling considerations**, and** Solution of two dimensional partial differential equations under different Geometric conditions

UNIT-A **15 HOURS**

Introduction to finite element methods, comparison with finite difference methods, Methods of weighted residuals, collocations, least squares and Galerkin's method.Variational formulation of boundary value problems equivalence of Galerkin and Ritz methods. Applications to solving simple problems of ordinary differential equations.

UNIT-B **12 HOURS**

Linear, quadratic and higher order elements in one dimensional and assembly, solution of assembled system.

UNIT-C **13 HOURS**

Simplex elements in two and three dimensions, quadratic triangular elements, rectangular elements, serendipity elements and isoperimetric elements and their assembly, Discretization with curved boundaries.

UNIT-D **12 HOURS**

Interpolation functions, numerical integration, and modeling considerations**.**
Solution of two dimensional partial differential equations under different Geometric conditions.

Books Recommended

1. Reddy, J.N. *Introduction to the Finite Element Methods*. Tata McGraw-Hill, 2003.Print.

2. Bathe, K.J. *Finite Element Procedures*. Prentice-Hall, 2001**.**Print.

3. Cook, R.D., D.S. Malkus and M.E. Plesha. *Concepts and Applications of Finite Element Analysis*. John Wiley and Sons, 2002.Print.

4. Hughes, Thomas J.R. *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis*. Dover Publication, 2000.Print.

5. Buchanan, George R. *Finite Element Analysis*. McGraw Hill, 1994.Print.

L	T	P	Credits
5	1	0	6

Course Title: Mathematical Finance
Course Code: MTH 141

Course Objective: The objective of this course is to demonstrate a broad, systematic and critical knowledge of the mathematical, statistical and computing methods appropriate for specifying mathematical problems in banks and other financial institutions.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT-A **15 HOURS**

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson Methods), comparison of NPV and IRR. Bonds, bond prices and yields.

UNIT-B **15 HOURS**

Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds.

UNIT-C **15 HOURS**

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).

UNIT-D **15 HOURS**

Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen's index.

Books Recommended

1. Luenberger, David G. *Investment Science.* Delhi: Oxford University Press, 1998.Print.

2. Hull, John C. *Options, Futures and Other Derivative.* India: Prentice-Hall, 2006.Print.

3. Ross, Sheldon. *An Elementary Introduction to Mathematical Finance*. USA: Cambridge University Press, 2003.Print.

L	T	P	Credits
2	0	0	2

Course Title: Logic and Sets
Course Code: MTH 142

Course Objective: The objective of this course is to acquaint the students with the basic concepts in Discrete Mathematics, which includes the topic like Mathematical Logic, Recursive Relations and Boolean algebra.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT-A **8 HOURS**

Logic: Introduction, propositions, truth table, negation, conjunction and disjunction, implications, bi-conditional propositions, converse, contra positive, inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

UNIT-B **7 HOURS**

Set Theory: Natural Numbers- Well Ordering Principle, Principle of Mathematical Induction, Sets, subsets, Set operations and the laws of set theory and Venn diagrams, examples of finite and infinite sets, Finite sets and counting principle. Empty set, properties of empty set.

UNIT-C **8 HOURS**

Set Operations: Standard set operations, classes of sets, power set of a set, difference and symmetric difference of two sets, set identities, generalized union and intersections.

UNIT-D **9 HOURS**

Relations and Functions: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, Hasse diagram, Functions, Special functions, Composition of Functions, one-one, onto and Inverse of a function, Number of one-one functions.

Books Recommended

1. Grimaldi, R.P. *Discrete Mathematics and Combinatorial Mathematics*. Pearson Education, 1998.
2. Halmos, P.R. *Naive Set Theory*. Springer, 1974.
3. Kamke, E. *Theory of Sets*. Dover Publishers, 1950.
4. Rosen K.H., *Discrete Mathematics and its Applications*, 6th edition. McGraw Hill, 2007.
5. Malik D.S., and M.K. Sen. *Discrete Mathematical Structures: Theory and Applications*. New Delhi: Thomson Cengagae Learning, 2004.
6. Ram, B. *Discrete Mathematics*. Pearson Publications, 2011.

Course Title: Applications of Algebra

L	T	P	Credits
5	1	0	6

Course Code: MTH 143

Course Objective: The aim of this course is to make the students learn about the applications of algebra such as Coding theory, Fibonacci numbers.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Understand the basics of coding, generators, decoding and incidence matrices.
CO2: Have a detailed knowledge of a special class of matrices, colouring patterns and related theorems.
CO3: Understand the concepts of quadratic forms, diagonalization and apply it for statistical and image processing related problems.
CO4: Understand the concepts of linear transformations, solutions of linear equations and linear algorithms.

UNIT-A **15 HOURS**

Balanced incomplete block designs (BIBD): definitions and results, incidence matrix of a BIBD, construction of BIBD from difference sets, construction of BIBD using quadratic residues, difference set families, construction of BIBD from finite fields, Coding Theory: introduction to error correcting codes, linear cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.

UNIT-B **15 HOURS**

Symmetry groups and color patterns: review of permutation groups, groups of symmetry and action of a group on a set; colouring and colouring patterns, Polya theorem and pattern inventory, generating functions for non-isomorphic graphs, Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices, Frobenius- König theorem, Birkhoff theorem.

UNIT-C **15 HOURS**

Positive Semi-definite matrices: positive semi-definite matrices, square root of a positive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and statistics.

UNIT-D **15 HOURS**

Applications of linear transformations: Fibonacci numbers, incidence models, and differential equations, Least squares methods: Approximate solutions of system of linear equations, approximate inverse of an m×n matrix, solving a matrix equation using its normal equation, finding functions that approximate data. Linear algorithms: LDU factorization, the row reduction algorithm and its inverse, backward and forward substitution, approximate inverse and projection algorithms.

Books Recommended

1. Herstein, I. N., and D. J. Winter. *Primer on Linear Algebra*. New York: Macmillan Publishing Company, 1990.Print.
2. Nagpaul, S. R, and S. K. Jain. *Topics in Applied Abstract Algebra*. Belmont: Thomson Brooks and Cole, 2005.Print.
3. Klima, Richard E, Neil Sigmon, and Ernest Stitzinger. *Applications of Abstract Algebra with Maple*. CRC Press LLC: Boca Raton, 2000.Print.
4. C Lay, David. *Linear Algebra and its Applications* 3rd Ed. Pearson Education Asia Indian Reprint, 2007.print.
5. Zhang, Fuzhen. *Matrix theory*. Springer-Verlag New York Inc: 1999.Print.

L	T	P	Credits
0	0	4	2

Course Title: Latex and HTML
Course Code: MTH 144

List of Practicals:

1. Elements of LaTeX
2. Hands-on-training of LaTex
3. Graphics in LaTeX
4. PSTricks
5. Beamer presentation
6. HTML/ Documents /Headings/Paragraphs/Links/Images/Buttons etc.
7. Creating simple web pages, images and links, design of web pages.

Books Recommended

1. J. Erickson, Martin, and Donald Bindner. *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press: Boca Raton FL, 2011.Print.
2. Lamport, L. *A Document Preparation System User's Guide and Reference Manual.* New York: Addison-Wesley, 1994.Print.

L	T	P	Credits
5	1	0	6

Course Title: Combinatorial Mathematics
Course Code: MTH 145

Course Objective: An introduction to fundamental combinatorial objects, their uses in other fields of mathematics and its applications, and their analysis.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Learn fundamental counting techniques, binomial theorem and partitions.
CO2: Understand the concepts of inclusion, exclusion and generating functions.
CO3: Understand the concepts of recurrence relations and system of representatives.
CO4: Learn Polya theory, its related theorems, Latin squares and symmetric designs.

UNIT-A **15 HOURS**

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers.

UNIT-B **15 HOURS**

Principle of Inclusion and Exclusion, Derangements, Inversion formulae. Generating functions: Algebra of formal power series, Generating function models, calculating generating functions, Exponential generating functions.

UNIT -C **15 HOURS**

Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.Integer partitions, Systems of distinct representatives.

UNIT-D **15 HOURS**

Polya theory of counting: Necklace problem and Burnside's lemma, Cyclic index of a permutation group, Polya's theorems and their immediate applications. Latin squares, Hadamard matrices, Combinatorial designs: *t* designs, BIBDs, Symmetric designs.

Books Recommended

1. Van Lint, J.H, and R.M. Wilson. *A Course in Combinatorics* 2nd Ed. Cambridge University Press, 2001.Print.
2. Krishnamurthy, V. *Combinatorics Theory and Application*. Affiliated East-West Press, 1985.Print.
3. Cameron, P.J. *Combinatorics Topics, Techniques, Algorithms*. Cambridge University Press, 1995. Print.
4. Hall, M. Jr. *Combinatorial Theory* 2nd Ed. John Wiley & Sons, 1986. Print.
5. Sane, S.S. *Combinatorial Techniques*. Hindustan Book Agency, 2013. Print.
6. Brualdi, R.A. *Introductory Combinatorics* 5th Ed. Pearson Education Inc, 2009.Print.

L	T	P	Credits
2	0	0	2

Course Title: Vedic Mathematics
Course Code: MTH 146

Course Objective: The objective of this course is to teach students the shortcut techniques which carries out numerical calculations in faster way. This will help students to develop their mental abilities.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT-A **8 HOURS**

Addition, Subtraction, Multiplication, Division, Divisibility.

UNIT-B **8 HOURS**

Square and Square root, Cube and Cube root, Decimal, Factorization, Highest Common Factor (HCF) , Least Common Multiple (LCM).

UNIT-C **8 HOURS**

Simple Equations, Quadratic Equations, Cubic Equations, Biquadratic Equations, Simultaneous Equations

UNIT-D **8 HOURS**

Factorizations and Differential Calculus, Partial Fractions, Integration by Partial Fractions, Pythagoras Theorem, Appolonius Theorem, Analytical Geometry

Books Recommended

1. Shashtri, P.R. *Vedic Mathematics*. Meerut: Arihant Publications, 7th Ed. 2011.
2. Maharaja, B.K.T. *Vedic Mathematics.* Delhi:Motilal Banarasidass Publishers Pvt. Lt. 1998.

L	T	P	Credits
4	0	0	4

Course Title: Optics and Lasers
Course Code: PHY153A
Total Lectures: 60

AIM: The aim and objective of the course on **Optics and Lasers** for the students of B.Sc. (Hons) Chemistry is to enable them to understand the different phenomenon exhibited by the light as well as the basics of the laser light.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT I

Interference **(12 Lectures)**

Young's double slit experiment, Coherent Source, Theory of interference fringes, Types of interference, Fresnel's biprism, thickness of thin transparent sheet, Interference in thin films, Newton's rings and their application, Michelson Interferometer, Application of thin film interference; Anti reflection coatings; dielectric mirrors; interference filters; Holography.

UNIT II

Diffraction **(12 Lectures)**

Difference between Fresnel and Franunhoffer diffraction, Franunhoffer diffraction at a single slit and its discussion, Fraunhoffer diffraction at double slit, missing orders in a double slit, Diffraction of N

slits and its discussion, Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating.

UNIT III

Polarization **(11 Lectures)**

Polarised light and its production; polarisers and analyzers; anisotropic crystals; Polarization by transmission and reflection, Malus Law, Brewster's Law, Polarization by refraction, anisotropic crystals, Theory of double refraction, Elliptically and circularly polarized light, Quarter wave and half wave plates, Production and detection of polarized light, Optical activity, specific rotation. Half shade polarimeter; LCD's.

UNIT IV

Lasers **(10 Lectures)**

Attenuation of light in an optical medium; thermal equilibrium; interaction of light with matter; Einstein relations; light amplification; population inversion; active medium, pumping; metastable states; principle pumping schemes; optical resonant cavity; axial modes; gain curve and laser operating frequencies, transverse modes; types of lasers; Qswitching; laser beam characteristics and applications.

Reference Books:

1. Subramanayam, N.; Lal, B. and Avadhamulu; M. N. *Textbook of Optics.* New Delhi: S. Chand & Company, 2006.
2. Jenkins, F.A.; White, H.E. *Fundamentals of Optics.* USA: McGrawHill Publication,
3. Ghatak,A. *Optics.* New Delhi:Tata McGraw Hill Publication, 2008.

Course Title: Optics Lab

L	T	P	Credits
0	0	4	2

Course Code: PHY154

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipments.

(60hrs)

Note:

- Students are expected to perform at least sixteen experiments out of following list.
- The examination for both the courses will be of 3hours duration.
- Total marks of practical will include 20% weightage of Continuous Assessment and 80% end semester exam including Notebook / Viva / Performance/ written test**.**

List of Experiments:

Experimental skills: General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results

List of Experiments: Students are expected to perform at least eight experiments out of following list.

1. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
2. To determine the Dispersive Power of the Material of a given Prism using Mercury Light.
3. To determine the Resolving Power of a Prism.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine the Thickness of a Thin Paper by measuring the Width of the Interference Fringes produced by a Wedge Shaped Film.
7. To determination Wavelength of Sodium Light using Michelson's Interferometer.
8. To determine the wavelength of Laser light using Diffraction of Single Slit.
9. To determine the wavelength of (1) Sodium and (2) Mercury Light using Plane Diffraction Grating.
10. To determine the Dispersive Power of a Plane Diffraction Grating.
11. To determine the Resolving Power of a Plane Diffraction Grating.
12. To determine the (1) Wavelength and (2) Angular Spread of HeNe Laser using Plane Diffraction Grating.
13. To study the wavelength of spectral lines of sodium light using plane transmission grating.
14. To study the specific rotation of sugar solution Laurents half shade polarimeter method
15. To study the numerical aperture and propagation losses using HeNe laser Optical fibre set up.
16. To compare the focal length of two lenses by Nodal slide method

Course Title: MODERN PHYSICS

L	T	P	Credits
4	0	0	4

Course Code: PHY155A
Total Lectures: 60

The aim and objective of the course on Modern Physics for the student of B.Sc. (Hons.) Chemistry is to equip them with the knowledge of wave particle duality, quantum mechanics and atomic nucleus and radioactivity.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT I

Wave Particle Duality **(10 Lectures)**

Quantum theory of light, Xrays and their diffraction, Compton effect, pair production, Wave Properties of Particles;de Broglie waves, waves of probability, the wave equation, phase and group velocities, particle diffraction, uncertainty principle and its applications.

UNIT II

Quantum Mechanics **(11 Lectures)**

Difference between classical and quantum mechanics, wave function and wave equations. Schrodinger's equation, time dependent and steady state forms, Expectation values, particle in a box, reflection and transmission by a barrier, tunnel effect, harmonic oscillator.

UNIT III

Quantum Theory of Hydrogen Atom **(12 Lectures)**

Schrodinger's equation for the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number,
Magnetic quantum number, electron probability density, radiative transitions, selection rules. Zeeman Effect, Anomalous Zeeman effect, X-ray Spectra.

UNIT IV

Atomic Nucleus and Radioactivity **(12 Lectures)**

Nonexistence of electrons in the nucleus, The neutron, stable nuclei, nuclear sizes and shapes, binding energy, liquid drop model, shell model, meson theory of nuclear forces Radioactivity; Radioactive decay, Half-life, radioactive dating, radioactive series, alpha decay and its theory, beta decay, gammadecay, radiation hazards and radiation units.

Books:

1. Beiser, A.*Concepts of Modem Physics*: McGraw Hill, 1987.
2. Ghatak and Loknatham. *Quantum Mechanics*:(Springer), 2004.
3. Kuhn, H. *Atomic Spectra*:. (Longman Green). 1969.
4. Hyde, K. *Basic ideas and Concepts in Nuclear Physics*: (Institute of Physics), 2004.

L	T	P	Credits
0	0	4	2

Course Title: Modern Physics Lab
Course Code: PHY156

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipment.

Note:

- Students are expected to perform at least eighteen experiments out of following list.
- The examination for both the courses will be of 3 hours duration.
- Total marks of practical will include 20% weightage of Continuous Assessment and 80% end semester exam including Notebook / Viva / Performance/ written test**.**

List of Experiments:

Experimental skills: General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results

1. Determination of Planck's constant using photocell.
2. Study of Solar Cell characteristics
3. To find half-life period of a given radioactive substance using GM counter
4. Study of C.R.O. as display and measuring device, Study of Sinewave, square wave signals (half wave and full wave rectification)
5. Determination of ionization potential of mercury.
6. Study of excitations of a given atom by Franck Hertz set up.
7. To determine charge to mass ratio (e/m) of an electron by Thomson method.
8. Study of Arc emission spectrum of given samples (Fe and Cu).
9. To determine the heat capacity of given materials.
10. To find conductivity of given semiconductor crystal using four probe method.
11. To determine the Hall coefficient and mobility of given semiconductors.
12. To determine the operating plateau and dead time of a given G.M. Counter.
13. To find the coefficient of thermal conductivity of a bad conductor by Lee’s method.
14. To find the ionization potential of mercury using gas filled diode.
15. To determine the thermionic work function of tungsten using directly heated diode.

16. To determine the speed of light in air.
17. To study the various laws of thermal radiation.
18. To demonstrate diaparaferro magnetism in an inhomogeneous magnetic field.
19. To measure the wave lengths of Balmar series of visible emission line from hydrogen.
20. To determine the electronic charge by Millikan oil drop method.

Course Title: Electricity Magnetism and Electronics

L	T	P	Credits
4	0	0	4

Course Code: PHY253A
Total Lectures: 60

Course Objectives:
This course is intended to learn the basic concepts of Electricity Magnetism and Electronics. The present syllabus has been framed as per the latest UGC CBCS guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth importance of academic and laboratory skills for the undergraduate students.

Expected Prospective:
This course will equip students with the necessary chemical knowledge concerning the fundamentals in the basic areas of Electricity Magnetism and Electronics. The students will be able to pursue their career objectives in advance education, scientific research and teaching.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT I **(12 Lectures)**

Vector Analysis
Vectors and Vector properties, Components of Vectors, Unit Vectors, Product of Vectors.

Electric Charges and Field
Electric Charges, Conductors, Insulators and Induced Charges,Coulomb Law, Electric Field and Forces, Electric field Calculations, Electric field lines. ElectricDipoles.

Gauss law
Charges & Electric Flux and calculations, Gauss's Law, Electric Potential Energy and Potential Gradient.

UNIT II **(10 Lectures)**

Magnetism

Magnetism, magnetic field, Magnetic field lines and flux, motion of charges particle in Magnetic field, BioSavart law, Ampere law, Magnetic Materials, Faraday's Law, Maxwell equations

Dielectric: Dielectric and Gauss's Law in Dielectric.

Electromotive Force

Electromotive force & Circuits, Mutual Inductance, Self-Induction and Inductors

UNIT III **(12 Lectures)**

Conduction in Semiconductors Electrons and holes in semiconductor, carrier concentration, donor and acceptor impurities, charge densities, Fermi Level in semiconductors, diffusion, carrier lifetimes, continuity equation

Diode Characteristics

Qualitative theory of pn junction, pn diode, band structure of an open circuit diode, current components, qualitative theory of diode currents, VI Characteristics.

UNIT IV **(11 Lectures)**

Transistors

Junction Transistors, Transistor current components, transistor as an amplifier, CB and CE configuration

Applications

Half Wave rectifier, ripple factor, full wave rectifier, filters, photoconductivity, Photodiode

REFERENCE BOOKS:

1. Sears's *University Physics with Modern Physics*, Hugh D Young and Roger A Freedman, 12thEdition Pearson Education, 2008.
2. *Fundamentals of |Physics*, Resnick&Hlleday, 8th Edition Wile
3. *Electronic Devices and Circuits*: J. Millman and C.C. Halkias Tata McGraw Hill, 1991

Course Title: Electricity Magnetism and Electronics Lab

L	T	P	Credits
0	0	4	2

Course Code: PHY 254

Course Objectives:
This course is intended to learn the basic concepts of EM and Electronics Lab. The present syllabus has been framed as per the latest UGC CBCS guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth importance of academic and laboratory skills for the undergraduate students.

Expected Prospective:
This course will equip students with the necessary chemical knowledge concerning the fundamentals in the basic areas of EM and Electronics Lab. The students will be able to pursue their career objectives in advance education, scientific research and teaching.

List of Experiments:

Experimental skills: General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results

1. To verify the Thevenin, Norton, Superposition, and Maximum Power Transfer Theorem.
2. To measure the Input and Output Impedance of an Unknown Network and to convert it into Equivalent T and π Circuits.
3. To study (a) Halfwave Rectifier and (b) Fullwave Bridge Rectifier and investigate the effect of C, L and π filters.
4. To study the characteristics of pnjunction diode.
5. To study the Forward and Reverse characteristics of a Zener Diode and to study its use as a Voltage Regulator.
6. To study the Characteristics of a Photodiode.
7. To determine the Characteristics of pn junction of a Solar Cell.
8. To study the CE Characteristics of a Transistor.
9. To study the various Transistor Biasing Configurations.
10. To study the Frequency Response of Voltage Gain of aRCCoupled Amplifier.
11. To design an Oscillator of given specifications using Transistors.
12. To study the characteristics of Junction Field Effect Transistor.
13. To study the characteristic of Metal Oxide Semiconductor Field Effect Transistor.
14. To study the magnetic field produced by a current carrying solenoid using a pickupcoil/Hall sensor and to find the value of permeability of air.
15. To determine the frequency of A.C. mains using sonometer.
16. Determination of given inductance by Anderson's bridge.
17. To determine the value of an air capacitance by deSauty Method and to findpermittivity of air. Also, determine the dielectric constant of a liquid.
18. Study of R.C. circuit with a low frequency a.c. source.
19. Studies based on LCR Board: Impedance of LCR circuit and the phase and between voltage and current.
20. To measure low resistance by Kelvin’s double bridge/ Carey Foster’s bridge.

21. To study the basic ideas of equal a priori probability, law of two independent events, and probability distribution of identical particles in two compartments for a two option system using colored dice.

Course Title: Mechanics and Waves

L	T	P	Credits
4	0	0	4

Course Code: PHY 353A
Total Lectures: 60

Course Objectives:
This course is intended to learn the basic concepts of Mechanics and Waves. The present syllabus has been framed as per the latest UGC CBCS guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth importance of academic and laboratory skills for the undergraduate students.

Expected Prospective:
This course will equip students with the necessary chemical knowledge concerning the fundamentals in the basic areas of Mechanics and Waves. The students will be able to pursue their career objectives in advance education, scientific research and teaching.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT I **(11 Lectures)**

LAWS OF MOTION
Inertial reference frame, Newton's laws of motion, motion in uniform field, components of velocity and acceleration in different coordinate systems, uniformly rotating frame, fictitious force, Coriolis force and its applications.

UNIT II **(11 Lectures)**

CENTRAL FORCES
Conservative and Non-conservative forces, Two particle central force problem, reduced mass, equation of motion, conservation of linear and angular momenta, conservation of energy, Nature of motion under central force and differential equation of motion under central force, Kepler's laws.

UNIT III **(11 Lectures)**

SIMPLE HARMONIC MOTION

Simple harmonic motion, differential equation of S.H. M. and its solution, velocity and acceleration of S.H.M., Energy of a simple harmonic oscillator, examples of simple harmonic motion, similarities between electrical and mechanical oscillators.

UNIT IV **(12 Lectures)**

WAVE MOTION

Type of waves, the wave equation and its solution, Characteristic impedance of a string, Impedance matching, Reflection and transmission of energy, Reflected and transmitted energy coefficients, Standing waves on a string of fixed length, Energy of a vibrating string. Wave and group velocity their measurements.

B**ooks:**

1. E.M. Purcell *Berkeley Physics Course* (Vol. 1), *Mechanics*, (Ed), McGrawHill Publication.
2. Feymman, R. P.; Lighton, R. B.; Sands,M.; *The Feymman Lectures in Physics* (Vol. 1), BI Publications, Delhi
3. Puri,S.P. *Fundamentals of Vibration and Waves*, Tata McGraw Hill Company, New Delhi.
4. Arora, C.L. and Hemne,P.S. *Physics for degree students*, S. Chand Company, New Delhi 2010.
5. Tayal, D.C. *Mechanics* Himalayan Publishing House, Mumbai, 2013.
6. Srivastava,P.K. "*Mechanics*" (New Age International).

Course Title: Mechanics and Waves Laboratory

L	T	P	Credits
0	0	4	2

Course Code: PHY 354

Course Objectives:
This course is intended to learn the basic concepts of Mechanics and Waves Laboratory. The present syllabus has been framed as per the latest UGC CBCS guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth importance of academic and laboratory skills for the undergraduate students.

Expected Prospective:
This course will equip students with the necessary chemical knowledge concerning the fundamentals in the basic areas of Mechanics and Waves Laboratory. The students will be able to pursue their career objectives in advance education, scientific research and teaching.

(60 hrs.)

List of Experiments:

Experimental skills: General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results

1. Use of Verniercallipers, Screw gauge, Spherometer, Barometer,Sphygmomanometer, Lightmeter, dry and wet thermometer, TDS/conductivity meterand other measuringinstruments based on applications of the experiments. Use ofPlumb line and Spirit level.
2. To analyse the given experimental Data by using the least squares curve fitting and the knowledge of straight line fitting of the experimental data. Also determine the standard deviation and their use in expressing the experimental results. (Note: To achieve these objectives on a sample data of some experiment to be decided by the teacher concerned.)
3. To study the variation of time period with distance between centre of suspensionand centre of gravity for a bar pendulum and to determine:
   (i) Radius of gyration of bar about an axis through its C.G. and perpendicular toits length.
   (ii) The value of g in the laboratory.
4. Determination of acceleration due to gravity ‘g’ by Kater's pendulum method.
5. To study moment of inertia of a flywheel.
6. Determination of height (of inaccessible structure) using sextant.
7. To determine the Young's modulus by (i) bending of beam using travelingmicroscope/laser, (ii) Flexural vibrations of a bar.
8. To study one dimensional collision using two hanging spheres of differentmaterials.
9. To study the magnetic field produced by a current carrying solenoid using a pickupcoil/Hall sensor and to find the value of permeability of air.
10. To determine the frequency of A.C. mains using sonometer.
11. To study C.R.O. as display and measuring device by recording sines and squarewaves, output from a rectifier, verification (qualitative) of law of electromagneticinduction and frequency of A.C. mains.
12. To measure thermo e.m.f. of a thermocouple as a function of temperature and findinversion temperature.
13. Determination of given inductance by Anderson's bridge.

14. To determine the value of an air capacitance by deSauty Method and to findpermittivity of air. Also, determine the dielectric constant of a liquid.
15. Study of R.C. circuit with a low frequency a.c. source.
16. Studies based on LCR Board: Impedance of LCR circuit and the phase and between voltage and current.
17. To measure low resistance by Kelvin's double bridge/ Carey Foster's bridge.

1. To study the basic ideas of equal a priori probability, law of two independent events, and probability distribution of identical particles in two compartments for a two option system using coloured dice.

L	T	P	Credits
2	0	0	2

Title: Operating Systems

Course Code: CSA260

Course Duration: 25-30 Hours

Course Objective: To understand and learn the fundamentals of Operating System including dealing with memory management, process management, CPU scheduling, deadlocks and file management.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT– A **10 Hours**

Introduction to Operating System

- OS, History of OS, Types of OS
- Functions/operations of OS, User services/jobs, system calls
- Traps, architectures for operating systems

CPU Scheduling

- Process states, virtual processors
- interrupt mechanism, scheduling algorithms

- Preemptive scheduling & Non-Preemptive scheduling

UNIT – B **7 Hours**

Process Management

- Process overview, process states and state transition
- Classical synchronization problems, Multithreading.

System Deadlock

- Deadlock characterization, Deadlock prevention and avoidance
- Deadlock detection and recovery, practical considerations

UNIT– C **7 Hours**

Storage Management

- Storage allocation methods: Single contiguous allocation
- Multiple contiguous allocation

Memory Management

- Paging, Segmentation combination of Paging and Segmentation
- Cache memory, hierarchy of memory types, associative memory.

UNIT – D

6 Hours

File Management

- Overview of File Management System
- Disk Space Management, Directory Structures

Device Management

- Goals of I/O software, Design of device drivers, Device scheduling policies

Reference Books:

1. Galvin and Silberschatz A., *Operating System Concepts*, Eigth Addition, New York: J. Wiley & Sons, 2009.
2. Crowley, *Operating Systems: A Design Oriented Approach*, New Delhi: Tata McGraw Hill, 2008.
3. Donovan J.J, *Systems Programming*, New York: McGraw Hill, 1972.
4. Dhamdhere. D.M, *System Programming and Operating Systems*, New Delhi: Tata McGraw Hill, 1999.
5. Madnick and Donovan, *Operating System*, New York: McGraw Hill, 1978.
6. Beck Leland L., *System Software*, Delhi: Pearson Education, 2000.
7. Henson P.B., *Operating System Principles*, Delhi: Prentice Hall
8. Tenenbaum A.S., *Operating System: Design and Implementation*, New Delhi: PHI, 2013.

Course Title: Database Management Systems

L	T	P	Credits
2	0	0	2

Course Code: CSA261
Course Duration: 25-30 Hours

Course Objective: The concepts related to database, database design techniques, transaction management, SQL, database operations are introduced in this subject. This creates strong foundation for data base creation.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT– A **7 Hours**

Data Base Concepts

- Data base vs. file oriented approach, Data Independence
- Data Base Models
  - General Architecture of a Data Base Management Software Components of a DBMS
  - Advantages and Disadvantages of DBMS

UNIT – B **7 Hours**

Introduction to Data Models

- Entity Relationship model, hierarchical model network model, relational model
- object oriented database, object relational database
  - Comparison of OOD & ORD, comparison of network, hierarchical and relational models.

UNIT – C **8 Hours**

Data Base Design

- Entities, Attributes, ER Diagrams
- Functional dependencies; Normalization
- Multivalued dependencies, decomposition
- Relational algebra and calculus
- The relational calculus query processor and optimizer, Storage organization for relations.

UNIT – D **8 Hours**

Database Protection

- Recovery
- Concurrency Management
- Database Security
- Integrity and Control
- Disaster Management

Reference Books:

1. Desai. B.C., *An Introduction to Database Systems*, New Delhi: Galgotia Publ. Private Ltd, 2000.
2. Date. C.J, *Data Base Systems*, Vols. I & II, New Delhi: Narosa Publishers, 2002.
3. Silberscatz, Korth and Sudarshan, *Database System Concepts*, Third Ed., New York: McGraw Hill International Editions, Computer Science Series, 2010.
4. Peter Rob Carlos Coronel, *Data Base Systems* (3rd Edition), New Delhi: Galgotia Publications (P) Ltd, 2001.

Course Title: Programming in C#

L	T	P	Credits
4	0	0	4

Course Code: CSA210
Course Duration: 45-60 Hours

Course Objective: This course provides the knowledge about creating windows forms, namespaces, assemblies, handling exceptions, casting, memory management and pointers. They also learn the concepts of threads and database connectivity.

Course Outcomes (COs): After successfully completing this course the students will be able to

UNIT-A

Introduction to .NET Environment **10 Hours**

- .Net Architecture, The Relationship of C# To .Net , The Common Language Runtime , Advantages of Managed Code, Use of Attributes, Deployment.
- The Common Language Runtime, Framework Base Classes, User and Programs Interface, Visual Studio .NET, .NET Languages, Benefits of The .NET Approach

UNIT-B

C# Fundamentals **13 Hours**

- C# Basics , Variables , Predefined Data Types : Value Types and Reference Types , CTS Types ,Conditional Statements ,Loops , Jump Statements , Enumerations
- Arrays , Using Statement , Namespace , Aliases , The Main() Method , Multiple Main Methods , Passing Arguments To Main() . More on Compiling C# Files, Console I/O, Using Comments.
- The C# Preprocessor Directives,C# Programming Guidelines. Objects and Type: Classes and Structs, Partial Classes, Static Classes, The Object Class Inheritance: Types of Inheritance, Virtual Methods, Hiding Methods, Calling Base Versions of Functions.
- Sealed Classes and Methods, Constructors of Derived Classes , Modifiers, Interfaces , Derived Interfaces
- Difference between C++ and C#, Difference between Java and C#.

UNIT-C **10 Hours**

Operators and Casts

- Operator Shortcuts, The Ternary Operator, The Checked and unchecked Operators, The Is Operator , The as Operator , The Sizeof Operator , The Type of Operator , Nullable Types and Operators , The Null Coalescing Operator , Operator Precedence
- Type Safety, Type Conversions, Boxing and Unboxing, Comparing Objects For Equality , Operator Overloading , User Defined Casts.

Object oriented aspects of C#

- Classes, Objects, Inheritance, Polymorphism, Interfaces,
- Operator Overloading, Delegates, Events, Errors and Exceptions

UNIT-D **12 Hours**

I/O and Object serialization

- I/O: System. I/O, Streams, TextWriter, TextReader

Writing windows forms applications and deploying windows forms applications

- Writing Windows Forms Applications: Understanding Windows Forms, Window Form Controls,Menus, MDI Forms

- Using Inheritance In Windows Forms, Using Common Dialog Controls,
- Deploying Windows Forms Applications
- Introduction To Deployment, ClickOnce Deployment,Creating An Installation Package For Project

Reference Books

1. Nagel Christian, Evgen Bill and GiynnJay, *Professional C# 2005*, Wrox Publications, 2006
2. Dietel & Dietel , *C# How to Program*, New Delhi: Pearson Education, 2007.
3. Sharp John & Jagger John,*Visual C#.Net*, New Delhi: PHI, New Delhi, 2005.
4. Francisco, *Visual Studio .Net*, Microsoft Publication, 2012.
5. Jones, Bradley L, *Teach Yourself C# in 21 Days*. Sams publishing, 2001
6. Balagurusamy, E., *Programming in C#*, New Delhi:Tata McGraw-Hill (UNIT I, II),2004.

Course Title: Programming in C# Laboratory

L	T	P	Credits
0	**0**	**4**	**2**

Course Code: CSA216

- Implementation of OOPs Concepts
- Namespaces
- Array and Strings
- Structures and Enumerations
- Delegates and Events
- Exception Handling

L	T	P	Credits
4	0	0	4

Course Title: Organic Chemistry
Course Code: CHE153

Course Objectives:
This course is intended to learn the basic concepts of Organic Chemistry. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO-1 To understand the basic reactions of hydrocarbons and its applications.
CO-2 To understand the basic concepts of stereochemistry and its application**.**
CO-3 To understand the mechanism of electrophilic and nucleophilic reaction and some important reactions of alcohols.
CO-4 To study the structure, properties and preparations of ethers, aldehydes and ketones with some named reaction.

PART A

Compounds of Carbon **(8 Hours)**

Differences in chemical and physical behaviour as consequences of structure. Discussion (with mechanism) of reactions of hydrocarbons' ranging from saturated acyclic and alicyclic, unsaturated dienes and aromatic systems. Huckel rule; as applied to 4n+2 systems. Industrial sources and utility of such compounds in daily life for medicine clothing and shelter.

PART B

Stereochemistry **(15 Hours)**

Structure, reactivity and stereochemistry. Configuration and conformation. Optical activity due to chirality; d,l, meso and diastereoisomerism, sequence rules. Reactions involving stereoisomerism. Geometrical isomerism – determination of configuration of geometric isomers. E & Z system of nomenclature. Conformational isomerism – conformational analysis of ethane and n-butane; conformations cyclohexane, axial and equatorial bonds, conformations of monosubstituted cyclohexane derivatives. Newman projection and Sawhorse formula, Fischer and flying wedge formulae.

PART C

Alkyl Halides **(8 Hours)**

Structure of alkyl halides and their physical properties. Preparation from alcohols, hydrocarbons, alkenes and by halide exchange method.

Reactions : (i) Nucleophilic substitution (SN2 and SN1) kinetics, mechanism, stereochemistry, steric and electronic factors, reactivity of alkyl halides, rearrangement, dependence on nucleophile, role of solvent (ii) Elimination E2 and E1 mechanism, stereochemistry, kinetics, rearrangement.

Alcohols **(4 Hours)**

Structure, physical properties (Hydrogen bonding), Methods of preparation: Grignard synthesis (scope and limitations),

Reactions: Reactions with hydrogen halides. Mechanism and rearrangement, Reaction with Phosphorous trihalides, mechanism of Dehydration rearrangement.

PART D

Ethers **(2 Hours)**

Structure, Physical properties, preparation (Williamson synthesis). Reactions: Cleavage, by acids, Electrophilic substitution in ethers.

Aldehydes and Ketones **(8 Hours)**

Structure, Physical Properties; Methods of Preparation: Oxidation of Primary and secondary alcohols, Oxidation of methylbenzenes, Reduction of acid chlorides, Friedel- Crafts Acylation,

Reactions; Nucleophilic addition, Addition of Grignard reagents, Addition of cyanide. Addition of Bisulphite, Addition of derivatives of ammonia. Acetal Formation, Cannizzaro reaction, Aldol Condensation.

Reference Books:

1. Morrison R.N. and Boyd, R.N. *Organic Chemistry,* Pearson Education, Dorling Kindersley (India) Pvt. Ltd.
2. Finar, I.L. *Organic Chemistry* (Volume 1), Pearson Education, Dorling Kindersley (India) Pvt. Ltd.
3. Eliel, E.L. and Wilen, S.H. *Stereochemistry of Organic Compounds,* London: Wiley, 1994.
4. March, Jerry. *Advanced Organic Chemistry: Reactions, Mechanism and Structure,* John Wiley, 6th edition, 2007

Course Title: ORGANIC CHEMISTRY LAB

L	T	P	Credits

Course Code: CHE154

0	0	3	2

Course Objectives:

This course is intended to learn the basic concepts of Organic Chemistry Laboratory. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in organic chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

1. Calibration of Thermometer

80-82^o (Naphthalene), 113-114^o (acetanilide).
132.5-133^o (Urea), 100^o (distilled Water)

2. Determination of melting point

Naphthalene 80-82^o, Benzoic acid 121.5-122^o
Urea, 132.5-133^o, Succinic acid 184-185^o
Cinnamic acid 132.5-133^o, Salicylic acid 157-5-158^o
Acetanilide 113-5-114^o, m-Dinitrobenzene 90^o
P-Dichlorobenzene 52^o. Aspirin 135^o.

3. Determination of boiling points

Ethanol 78^o, Cyclohexane 81.4^o, Toluene 110.6^o, Benzne 80^o.

4. Mixed melting point determination

Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

5. Distillation

Simple distillation of ethanol-water mixture using water condenser,
Distillation of nitrobenzene and aniline using air condenser.

6. Crystallization

Concept of induction of crystallization
Phthalic acid from hot water (using fluted filter paper and stemless funnel), Acetanilide from boiling water,
Naphthalene from ethanol,
Benzoic acid from water.

7. Decolorisation and crystallization using charcoal

Decolorisation of brown sugar (sucrose) with animal charcoal using gravity filtration.
Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixed with 0.3g of Congo Red using 1g decolorising carbon) from ethanol.

8. Sublimation (Simple and Vacuum)

Camphor, Naphthalene, Phthalic acid and Succinic acid.

9. Extraction: the separatory funnel, drying agent:

Isolation of caffeine from tea leaves

10. Steam distillation

Purification of aniline/nitrobenzene by steam distillation.

Reference Books:

1. 1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. and Smith, P.W.G. Vogel's Text Book of Practical Organic Chemistry, 5th edition, ELBS, 1989.
2. Pavia, D.L., Lampanana, G.M. and Kriz, G.S. Jr. Introduction to Organic Laboratory Techniques, Thomson Brooks/Cole, 3rd edition, 2005.
3. Mann, F.G. and Saunders. P.C. Practical Organic Chemistry, London: Green & Co. Ltd., 1978.
4. Svehla, G. Vogel's Qualitative Inorganic Analysis (revised), Orient Longman, 7th edition, 1996.
5. Bassett, J., Denney, R.C., Jeffery, G.H. and Mendham, J. Vogel's Textbook of Quantitative Inorganic Analysis (revised), Orient Longman, 4th edition, 1978.

L	T	P	Credits
4	0	0	4

Course Title: Spectroscopy
Course Code: CHE155
Course Objectives:
This course is intended to learn the basic of spectroscopy. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1 :Understand classification of molecules and rotational energy levels of different molecules**.**
CO2: Understand vibrational rotation spectra of different molecules and anharmonicity of molecular vibrations **.**
CO3: The students will acquire knowledge of measurement of IR and Raman spectra absorption of common functional groups
CO4: Understand the concept of ground and first excited electronic states and electronic spectra of various polyatomic molecules .

PART A

Pure Rotational Spectra (12 Hours)

Classification of molecules according to their moment of inertia. Rotational energy levels of hydrogen chloride. Determination of molecular geometry by rotational spectrum, isotopic substitution effects. Stark effect, Estimation of molecular dipole moments, Selection rules, Rotational Raman Spectra, anisotropic polarizabilty, specific selection rule in Raman Spectra, Stokes and anti – Stokes lines.

PART B

Vibrational Spectra (12 Hours)

Diatomic molecules, Force constants, Fundamental vibration frequencies, anharmonicity of molecular vibrations and its effect on vibrational frequencies, second and higher harmonies. Frequencies of the vibrational transitions of HCl. Vibrational rotation spectra of CO. P, Q and R branches.

PART C

Infrared and Raman Spectra (9 Hours)

Vibrations of polyatomic molecules. Examples of CO_2, H_2O.Mechanics of measurement of infrared and Raman spectra absorption of common functional groups. Their dependence on chemical environment (bond order, conjugation, hydrogen bonding), the number of active infrared and Raman active lines. Fermi resonance, combination bands and overtones, complications due to interactions of vibrations of similar frequency. Application of IR in structure elucidation of organic compounds.

PART D

UV and Visible Spectroscopy **(12 Hours)**

Measurement technique, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra. Chromophores, auxochromes, electronic spectra of polyatomic molecules. Woodward rules for conjugated dienes, unsaturated carbonyl groups, extended conjugation. Red shift, blue shift, hypo and hyperchromic effects.

Reference Books:

1 Silverstein, R.M. and Webster, F.X. Spectrometric Identification of Organic Compounds, Wiley, 6th edition, 2007.

2. Kemp, W. Organic Spectroscopy, ELBS, 1996.

3. Banwell, C.N. Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 4th edition, 1995.

4. Sharma, Y.R. Elementary Organic Spectroscopy; Principle and Chemical Applications, S. Chand & Company Ltd., 2005.

L	T	P	Credits	Marks
0	0	3	2	50

Course Title: Chemistry Lab

Course Code: CHE156

Course Objectives:

This course is intended to learn the basic concepts of Chemistry Laboratory. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

1. Determine the strength of HCl solution by titrating against NaOH solution conductometerically.
2. Determination of total hardness of water (tap) using standard EDTA solution and Eriochrome black T indicator.
3. Determination of alkalinity of water.
4. Determination of surface tension of given liquid by using Stalagmometer.
5. Determination of residual chlorine in a water sample.
6. To determine the specific and molecular rotations of an optically active substance by using polarimeter.
7. 2. To determine the composition of an unknown solution with a polarimeter.
8. Determination of the viscosity of given lubricating oil by using Redwood Viscometer.
9. Determination of distribution coefficient of I_2 between CCl_4 and Water.
10. To study the kinetics of hydrolysis of methyl acetate in the presence of hydrochloric acid.

Reference Books:

1. Levitt, B.P. Findlays Practical Physical Chemistry, London & New York: Longman Group Ltd. 8th edition, 1978.
1. Khosla, B.D., Garg, V.C. and Gulati, A. Senior Practical Physical Chemistry, New Delhi: R.Chand & Co., 11thedition, 2002.
2. Das, R.C. and Behra, B., Experimental Physical Chemistry, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Vogel's Textbook of Quantitative Chemical Analysis (revised by Jeffery, Bassett, Mendham and Denney), 5th edition, ELBS, 1989.
4. Svehla, G. Vogel's Qualitative Inorganic Analysis (revised), 6th edition, New Delhi: Orient Longman, 1987.
5. Christian G.D. Analytical Chemistry, John Wiley & Sons Inc.

Course Title: Inorganic Chemistry

L	T	P	Credits
4	0	0	4

Course Code: CHE253

Course Objectives:

This course is intended to learn the basic concepts of Inorganic Chemistry. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO1: Utilize the knowledge in quantum mechanics and periodic properties.
CO2: Understand the concept of lattice energy using Born-Landé and Kapustinskii expression, rationalize the conductivity of metals, semiconductors and insulators based on the Band theory, understand the importance and application of chemical bonds, weak chemical forces and their effects.
C03: Understand the concept of theories of covalent bonds Perceive the importance of structures and geometries of molecules using Radius Ratio Rules, VSEP Rand MO theory.
CO4: Understand the theories of coordination bonding, Isomerism, various ligands and factors affecting the stability of metal complexes.

PART A

Atomic Structure and periodic properties (12 Hours)

Wave mechanical model of Hydrogen atom, The de Broglie relationship, The uncertainty principle, Schrodinger wave equation and its derivation, Significance of Ψ and Ψ^2, Quantum numbers, Normal and orthogonal wave functions, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations. Concept of extra stability of half and completely filled electronic configuration, Electronic configuration of elements, Penetration and shielding (The Slater's rules). The origin and distribution of the elements, The structure of the periodic table, Atomic parameters and their variation in periodic table, Electronegativity and various scales.

PART B

Ionic Compounds (Bonding and structures) (12 Hours)

Properties of ionic substances, Occurrence of ionic bonding, The radius ratio rules, Efficiency of packing, Hexagonal close packing, Cubic close packing, Structures of different crystal lattices, Sodium chloride, Cesium chloride, Wurtzite, Zinc blende, Fluorite, Rutile, Cristobalite, Nickel arsenide, Calcium carbide, Lattice energy, Born-Haber cycle, The calculations of the lattice energy on the basis of Born-Lande equation, Covalent character in predominantly ionic compounds, Imperfections of crystals, Polarizing power and polarisability of ions, Fajan's rule.

PART C

Covalent Bond **(12 Hours)**

The Lewis theory, Valence bond theory - A mathematical approach, Resonance, Valence Shell Electron Pair Repulsion Model (VSEPR theory), Prediction of structures and variation of bond angles on the basis of VSEPR theory, Shortcomings of VSEPR theory. Concept of hybridization, Rules for obtaining hybrid orbitals, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3), Molecular orbital theory (LCAO method), Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules, Molecular orbital energy level diagrams (Be_2, N_2, O_2, F_2, NO, CO, HCl, NO_2, BeH_2).

PART D

Coordination chemistry **(8 Hours)**

Werner's theory, nomenclature of coordination complexes, isomerism in coordination complexes, chelating agents, metal chelates and chelate effects, names and abbreviations of important ligands, polydenate ligands, polypyarzolyborates, macrocylic ligands, macrocylic effect, ketoenolates, troplonates, tripod ligands, conformation of chelate rings, factors determining kinetic and thermodynamic stability.

Reference Books:

1 Shriver, D.F.C., Atkins, P.W. and Langford, C.H. *Inorganic Chemistry,* ELBS Oxford, 1991.

2. Huheey, J.E. Keiter, E.A. and Keiter, R.L. *Inorganic Chemistry,* 4th edition, Singapore: Pearson Education, 1999.

3. Lee, J.D. *Concise Inorganic Chemistry,* ELBS, Oxford, 1994.

L	T	P	Credits
0	0	3	2

Course Title: Inorganic Chemistry Lab

Course Code: CHE254

Course Objectives:

This course is intended to learn the basic concepts of Inorganic Chemistry Laboratory. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in inorganic chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

Qualitative Analysis

Identification of cations and anions in a mixture which may contain combinations of acid ions.
These must contain interferring acid anions and one, the insoluble.

a) Special Tests for Mixture of anions

I. Carbonate in the presence of sulphate.
II. Nitrate in the presence of nitrite
III. Nitrate in the presence of bromide and iodide.
IV. Nitrate in the presence of chlorate.
V. Chloride in the presence of bromide and iodide.
VI. Chloride in the presence of bromide.
VII. Chloride in the presence of iodide.
VIII. Bromide and iodide in the presence of each other and of chloride.
IX. Iodate and iodide in the presence of each other.
X. Phosphate, arsenate and arsenite in the presence of each other.
XI. Sulphide, sulphite, thiosulphate and sulphate in the presence of each other.
XII. Borate in the presence of copper and barium salts.
XIII. Oxalate in the presence of fluoride.
XIV. Oxalate, tartrate, acetate, citrate in the presence of each other.

b) Separation and identification of cations in mixtures

i) Separation of cations in groups.
ii) Separation and identification of Group I, Group II (Group IIA and IIB), Group III, Group IV, Group V and Group VI cations.

Reference Books:

1. 1. 1. Svehla, G. and Sivasankar, B. *Vogel's Qualitative Inorganic Analysis (revised),* Pearson, 7th edition, 1996.
2. Bassett, R. C., Denney, G. H. and Jeffery, J. Mendham, *Vogel's Textbook of Quantitative Inorganic Analysis (revised),* 4th edition, Orient Longman, 1978

L	T	P	Credits
4	0	0	4

Course Title: PHYSICAL CHEMISTRY

Course Code: CHE353

Course Objectives: This course is intended to learn the basic concepts of Physical Chemistry. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students.

Course Outcomes (COs): After successfully completing this course the students will be able to
CO-1 To understand various laws of thermodynamics and their applications.
CO-2 To understand the concept of chemical equilibria**.**
CO-3 To understand and apply the concept of kinetics and catalysis**.**
CO-4 To understand the concepts of conductance and electrochemistry.

PART A

Chemical Thermodynamics (15Hours)

Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy.

First Law of Thermodynamics: First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion, .Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchoff's equation.

Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot's cycle), Entropy, Entropy changes of an ideal gas with changes in P,V, and T, Free energy and work functions, Gibbs-Helmholtz Equation., Criteria of spontaneity in terms of changes in free energy, Third law of thermodynamics, Absolute entropies.

PART B

Chemical Equilibrium (5 Hours)

General characteristics of chemical equilibrium, thermodynamicderivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant-Van't Hoff equation, homogeneous & heterogeneous equilibrium, Le Chetalier's principle.

PART C

Chemical Kinetics (15 Hours)

Rates of reactions, rate constant, order and molecularity of reactions.Chemical Kinetics: Differential rate law and integrated rateexpressions for zero, first, second and third order reactions. Half-lifetime of

a reaction, Methods for determining order of reaction, Effect of temperature on reaction rate and the concept of activation energy, Reaction mechanism, Steady state hypothesis

Catalysis

Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis, Unimolecular surface reactions.

PART D

Electro-Chemistry (5 Hours.)

Specific conductance, molar conductance and their dependence on electrolyte concentration, Ionic Equilibria and conductance, Essential postulates of the Debye-Huckel theory of strong electrolytes, Mean ionic activity coefficient and ionic strength, Transport number and its relation to ionic conductance and ionic mobility, Conductometric titrations, pH scale, Buffer solutions, salt hydrolysis, Acid-base indicators.

Electrochemical cells (5Hours.)

Distinction between electrolytic and electrochemical cells, Standard EMF and electrode potential, Types of electrodes, Reference electrode, Calculation of NG, NH, NS and equilibrium constant from EMF data, Potentiometric determination of pH, Potentiometric titrations.

Reference Books:

1. Atkins, P.W. *Physical Chemistry,* Oxford University Press, 8th edition, 2006 (Indian Print).
2. Engel, T. and Reid, P. *Physical Chemistry,* Pearson Education, 1st edition, 2006.
3 Castellan, G. W. *Physical Chemistry,* Wisley/Narosa, 3rd edition, 1985 (Indian Print).
4. Barrow, G. M. *Physical Chemistry,* New York: McGraw Hill, 6th edition, 1996.
5. Silbey, R. J., Albert, R. A. and Bawendi, Moungi G. *Physical Chemistry,* 4th edition, New York: John Wiley, 2005.

L	T	P	Credits
0	0	3	2

Course Title: PHYSICAL CHEMISTRY LAB

Course Code: CHE354

Course Objectives:

To teach the fundamental concepts of Physical Chemistry and their applications. The syllabus pertaining to B.Sc. (Other branches.) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Expected Prospective:

The students will be able to understand the basic objective of experiments in organic chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

1. Treatment of experimental data

Recording of experimental data. Significant number, accuracy and precision, error analysis.

2. Liquids and Solutions

(i) To determine relative viscosities of aqueous solutions of glycerol at different concentrations. (ii) Calculate partial molar volume of glycerol at infinite dilution from density measurement.

(ii) To determine viscosity-average molecular weight, number-average molecular weight and mean diameter of polyvinyl alcohol molecule from intrinsic viscosity data.

3. Thermochemistry

(i) To determine heat capacity of a calorimeter and heat of solution of a given solid compound.

(ii) To determine heat of solution of Solid calcium chloride and calculate lattice energy of calcium chloride using Born-Haber cycle.

(iii) To determine heat of hydration of copper sulphate.

4. Distribution Law

(i) To determine distribution (i.e. partition) coefficient of a solute between water and a non-aqueous solvent.

5. Surface Phenomena

To study the adsorption of acetic acid/oxalic acid from aqueous solution on charcoal. Verify Freundlich and Langmuir adsorption isotherms.

6. Colorimetery

(i) To verify Lambert-Beer law.

7. pH-metry

(i) To titrate a strong acid against a strong base pH-metrically.

(ii) To titrate a weak acid against a strong base and determine the ionization constant of the weak acid.

Reference Books :

1 Levitt, B.P. *Findlays Practical Physical Chemistry,* London & New York: Longman Group Ltd., 8th edition, 1978.

2. Khosla, B.D., Garg, V.C. and Gulati, A. *Senior Practical Physical Chemistry,* New Delhi: R. Chand & Co., 11thedition, 2002.

3. Das, R.C. and Behra, B. *Experimental Physical Chemistry,* Tata McGraw Hill Publishing Co. Ltd. 1983.

4. *Vogel's Textbook of Quantitative Chemical Analysis* (revised by Jeffery, Bassett, Mendham and Denney), ELBS, 5th edition, 1989.

5. Svehla, G. *Vogel's Qualitative Inorganic Analysis (revised),* 6th edition, New Delhi: Orient Longman, 1987.
6. Christian, G.D. *Analytical Chemistry,* Wiley, 6th edition.