B.Sc. (Hons.) Mathematics

Course Structure and Syllabus

(Based on Choice Based Credit System)

Batch 2022 & onwards

DEPARTMENT OF MATHEMATICS

VISION

To be among the best mathematics departments in the region and to establish a national reputation as a centre for research and teaching in mathematics. Moreover, the department will contribute to the development of students as mathematical thinkers, and to function as productive citizens.

MISSION

- To discover, mentor, and nurture mathematically inclined students, and provide them a supportive environment that fosters intellectual growth.
- To prepare our undergraduate and graduate students to develop the attitude and ability to apply mathematical methods and ideas in a wide variety of careers.
- To perform widely recognized research in focused areas of mathematical and statistical theory, methodology, and education.
- To advocate for mathematical sciences and UTEP in schools and the local community.

B.Sc. (Honours Mathematics) Program

PROGRAM OBJECTIVES

Objective of the program is to catch young and talented students to motivate them to study Mathematics and to nurture them to develop their mathematical reasoning and logics. Other objectives of the program are to inspire students to pursue study in higher mathematics and grow as a skilful mathematician to cater the needs of knowledgeable society.

Duration: B.Sc. (Hons) Mathematics is a graduate level program offered by the Department of Mathematical Sciences. This is a 3-years program, consisting of six semesters with two semesters per year.

Program Code: BSHM (Bachelor of Science (Hons) in Mathematics)

Eligibility: 10+2 in any stream with Mathematics as one of the subjects with at least 50% marks in aggregate

PROGRAM EDUCATIONAL OBJECTIVES: At the end of the program, the student will be able to:

PEO1	Apply principles of basic science concepts in understanding, analysis and prediction of mathematical systems.
PEO2	Develop human resource with knowledge, abilities and insight in Mathematics and related fields required for career in academia and industry.
PEO3	Engage in lifelong learning and adapt to changing professional and societal needs.

PROGRAM SPECIFIC OUTCOMES

At the end of the program,

PSO1	Students will be able to understand the nature of Mathematics and shall be ready to study higher 'Abstract Mathematics'.
PSO2	Students will be able to visualize the importance of Mathematics and apply the knowledge of Mathematics in Physical, Chemical and Social Sciences.
PSO3	Students will be able to use latest mathematical tools and software.
PSO4	Students will be able to formulate computer codes to tackle the complex mathematical problems.
PSO5	Students will become more confident due to enhanced level of reasoning, logics, skills and shall be able to understand the needs of the society.

PROGRAM OUTCOMES: At the end of the program, the student will be able to:

PO1	Understand the concepts of different branches of Mathematics.
PO2	Demonstrate expertise to conduct wide range of scientific modelling.
PO3	Apply the concepts of mathematics in areas of mechanics, analysis, calculus, algebra, geometry, mathematical modelling etc., in industry, academia, and day-to-day life.

Scheme of the Program: B.Sc. (Hons.) Mathematics

SEMESTER FIRST **Contact Hrs. 24 Hrs.**

S.No.	Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
				L	T	P	Internal	External		
1.	BSHM-101-22	Compulsory	Calculus-I	**4**	**-**	**-**	**40**	**60**	**100**	**4**
2.	BSHM-102-22		Algebra	**5**	**1**	**-**	**40**	**60**	**100**	**6**
3.	BSHM-103-22		Programming Lab-I	**-**	**-**	**4**	**30**	**20**	**50**	**2**
4.	BHHL-115-22		Communicative English	**2**	**-**	**-**	**20**	**30**	**50**	**2**
5.*	BSHP-111-21	Elective	Optics	**3**	**1**	**-**	**40**	**60**	**100**	**4**
	BSHP-113-21		Physics Lab-I	**-**	**-**	**4**	**30**	**20**	**50**	**2**
	UGCA-1902		Fundamentals of Computer and IT	**3**	**1**	**-**	**40**	**60**	**100**	**4**
	UGCA-1906		Fundamentals of Computer and IT (Laboratory)	**-**	**-**	**4**	**30**	**20**	**50**	**2**
				Total						**20**

L: Lectures T: Tutorial P: Practical Cr: Credits

Note*: Physics (BSHP-111-21 & BSHP-113-21) are compulsory for the Students with Non-Medical background. Students without Non-medical background should opt Fundamentals of Computer and IT (UGCA-1902 & UGCA-1906).

SEMESTER SECOND **Contact Hrs. 24 Hrs.**

S.No.	Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
				L	T	P	Internal	External		
1.	BSHM-201-22	Compulsory	Real Analysis	**5**	**1**	-	**40**	**60**	**100**	**6**
2.	BSHM-202-22		Differential Equations	**4**	**-**	-	**40**	**60**	**100**	**4**
3.	BSHM-203-22		Programming Lab-II	-	-	**4**	**30**	**20**	**50**	**2**
4.*	BHHL-116A-22 **Or** BHHL-116B-22		Punjabi Compulsory **Or** Mudli Punjabi	**2**	**-**	**-**	**20**	**30**	**50**	**2**
5.**	BHIC-111-22	Elective	Chemistry-I	**3**	**1**	-	**40**	**60**	**100**	**4**
	BHIC-112-22		Chemistry Lab-I	-	-	**4**	**30**	**20**	**50**	**2**
	BBA-GE-201-18		Managerial Economics-II	**5**	**1**	**0**	**40**	**60**	**100**	**6**
				Total						**20**

L: Lectures T: Tutorial P: Practical Cr: Credits

Note 1*: Students with Punjabi as a passing subject in 10th class will study Punjabi Compulsory (BHHL-116A-22). Students without Punjabi as a subject in 10th class will study Mudli Punjabi (BHHL-116B-22).

Note 2: Chemistry (BHIC-111-22 & BHIC-112-22) is compulsory for the Students with Non-Medical background. Students without Non-medical background should opt Managerial Economics-II (BBA-GE-201-18).**

SEMESTER THIRD **Contact Hrs. 28 Hrs.**

S.No.	Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
				L	T	P	Internal	External		
1.	BSHM-301-22	Compulsory	Theory of Real Functions	**5**	**1**	-	**40**	**60**	**100**	**6**
2.	BSHM-302-22		Group Theory I	**5**	**1**	-	**40**	**60**	**100**	**6**
3.	BSHM-303-22		Multivariable Calculus	**5**	1	-	**40**	**60**	**100**	**6**
4.	BSHM-304-22		Logic and Sets	**2**	**-**	**-**	**20**	**30**	**50**	**2**
5.*	BSHP-212-21	Elective	Elements of modern physics	**3**	**1**	**-**	**40**	**60**	**100**	**4**
	BSHP-213-21		Physics Lab-III	**-**	**-**	**4**	**30**	**20**	**50**	**2**
6.*	UGCA-1914		Programming in Python	**3**	**1**	**-**	**40**	**60**	**100**	**4**
	UGCA-1917		Programming in Python (Laboratory)	**-**	**-**	**4**	**30**	**20**	**50**	**2**
				Total						**26**

L: Lectures T: Tutorial P: Practical Cr: Credits

Note*: Physics (BSHP-212-21 & BSHP-213-21) are compulsory for the Students with Non-Medical background. Students without Non-medical background should opt Programming in Python (UGCA-1914 & UGCA-1917).

SEMESTER FOURTH **Contact Hrs. 30 Hrs.**

S.No.	Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
				L	T	P	Internal	External		
1.	BSHM-401-22	Compulsory	Numerical Methods	**4**	**-**	-	**40**	**60**	**100**	**4**
2.	BSHM-402-22		Riemann Integration and Series of Functions	**5**	**1**	-	**40**	**60**	**100**	**6**
3.	BSHM-403-22		Ring Theory and Linear Algebra I	**5**	**1**	-	**40**	**60**	**100**	**6**
4.	BSHM-404-22		Programming Lab-III	-	-	**4**	**30**	**20**	**50**	**2**
5.	BSHM-405-22		Graph Theory	**2**	**-**	**-**	**20**	**30**	**50**	**2**
6.*	BHIC-211-22	Elective	Chemistry-II	**3**	**1**	**-**	**40**	**60**	**100**	**4**
	BHIC-212-22		Chemistry Lab-II	**-**	**-**	**4**	**30**	**20**	**50**	**2**
7.*	BBA-401-18		Business Research Methods	**5**	**1**	**-**	**40**	**60**	**100**	**6**
				Total						**26**

L: Lectures T: Tutorial P: Practical Cr: Credits

Note*: Chemistry (BHIC-211-22 & BHIC-212-22) is compulsory for the Students with Non-Medical background. Students without Non-medical background should opt Business Research Methods (BBA-401-18).

SEMESTER FIFTH **Contact Hrs. 30 Hrs.**

S. No.	Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
				L	T	P	Internal	External		
1.	BSHM-501-22	Compulsory	Partial Differential Equations	**4**	**-**	-	**40**	**60**	**100**	**4**
2.	BSHM-502-22		Group Theory-II	**5**	**1**	-	**40**	**60**	**100**	**6**
3.	BSHM-503-22		Introduction to Number Theory	**5**	**1**	-	**40**	**60**	**100**	**6**
4.	BSHM-504-22		Mathematical Statistics	**5**	**1**	-	**40**	**60**	**100**	**6**
5.	BSHM-505-22		Programming Lab-IV	-	-	**4**	**30**	**20**	**50**	**2**
6.	EVS-101 A		Environmental Science	**2**	-	-	**20**	**30**	**50**	**2**
7.	BSHM-506-22	Value Added Course (Compulsory)	Computer Algebra System and Related Software	-	-	**2**	**Satisfactory/ Unsatisfactory**			**Non-Credit**
				Total						**26**

L: Lectures T: Tutorial P: Practical Cr: Credits

SEMESTER SIXTH **Contact Hrs. 28 Hrs.**

S.No.	Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
				L	T	P	Internal	External		
1.	BSHM-601-22	Compulsory	Complex Analysis	5	1	-	40	60	100	6
2.	BSHM-602-22		Ring Theory and Linear Algebra-II	5	1	-	40	60	100	6
3.	BSHM-603-22		Theory of Equations	5	1	-	40	60	100	6
4.	BSHM-604-22		Mathematical Modeling	4	-	-	40	60	100	4
5.	BSHM-605-22		Programming Lab-V	-	-	4	30	20	50	2
6.	BSHM-606-22	Value Added Course (Compulsory)	Scientific Documentation Tool	-	-	2	Satisfactory/ Unsatisfactory			Non-Credit
				Total						24

L: Lectures T: Tutorial P: Practical Cr: Credits

Examination and Evaluation

Theory			
S. No.	**Evaluation criteria**	**Weightage in Marks**	**Remarks**
1	Mid term/sessional Tests	24	Internal evaluation (40 Marks) MSTs, Quizzes, assignments, attendance, etc., constitute internal evaluation. Average of two mid semester test will be considered for evaluation.
2	Attendance	6	
3	Assignments/Seminars/Presentations/Continuous Evaluation	10	
4	End semester examination	60	External evaluation
5	Total	100	Marks may be rounded off to nearest integer.
Practical			
1	Evaluation of practical record/ Viva Voice/Attendance/Seminar/ Presentation	30	Internal evaluation
2	Final Practical Performance + Viva-Voce	20	External evaluation
3	Total	50	Marks may be rounded off to nearest integer.

Instructions for Paper-Setter in B. Sc (Hons.) Mathematics

A. Scope

1. The question papers should be prepared strictly in accordance with syllabus and format as prescribed by the University.

2. The question paper should cover the entire syllabus with uniform distribution among each unit and weightage of marks for each question.

3. The language of questions should be simple, direct, and documented clearly and unequivocally so that the candidates may have no difficulty in appreciating the scope and purpose of the questions. The length of the expected answer should be specified as far as possible in the question itself.

4. The distribution of marks to each question/answer should be indicated in the question paper properly.

B. Type and difficulty level of question papers

1. Questions should be framed in such a way as to test the student's intelligence and understanding of the applied aspects of the subject. The weightage of the marks as per the difficulty level of the question paper shall be as follows:
   - i) Easy question 30%
   - ii) Average questions 50%
   - iii) Difficult questions 20%
2. The numerical content of the question paper should be up to 40%.

C. Format of question paper

1. Paper code and Paper-ID should be mentioned properly.
2. The question paper will consist of three sections: Sections-A, B and C.
3. Section-A is COMPULSORY consisting of TEN SHORT questions carrying two marks each (total 20 marks) covering the entire syllabus.
4. The Section-B consists of FOUR questions of eight marks each covering Unit I & II of syllabus (Taking two questions from each Unit I & II).
5. The Section-C consists of FOUR questions of eight marks each covering Unit III & IV of syllabus (Taking two questions from each Unit III & IV).
6. Sub-parts of the questions in Section B and C should be preferred for numerical/conceptual questions.
7. Attempt any five questions in all, selecting at least two questions from each of the two sections.

Question paper pattern for MST:

Roll No:	**No of pages:**
IK Gujral Punjab Technical University- Jalandhar	
Department of Mathematical Sciences	
Academic Session:	
Mid-Semester Test: I/II (Regular/reappear)	**Date:**
Programmse: B.Sc. (Hons.) Mathematics	**Semester:**
Course Code:	**Course:**
Maximum Marks: 24	**Time: 1 hour 30 minutes**

❖ Note: Section A is compulsory; Attempt any two questions from Section B and one question from Section C.

Section: A		**Marks**	**Cos**
1		2	
2		2	
3		2	
4		2	
Section: B			
5		4	
6		4	
7		4	
Section: C			
8		8	
9		8	

Details of Course Objectives

CO1	
CO2	
CO3	
CO4	
CO5	

SEMESTER-I

BSHM-101-22	**Calculus-I**	**L-4, T-0, P-0**	**4 Credits**

Pre-requisite: Elementary calculus of senior secondary level.

Course Objectives: The objectives of this course are to make the students understand the following:

1. The fundamental concepts of differential calculus.
2. The geometrical meaning of functions, limits, continuity, derivatives, mean value theorems.
3. Applications of derivatives.
4. The definition of Higher order derivatives and its basic applications.
5. The usability of Higher order derivatives to establish Taylor's theorem, Leibnitz theorem and Maclaurin theorem.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic concepts of Differential and Integral Calculus.
CO2	Visualize all concepts geometrically.
CO3	Sketch curves of the functions intuitively with the help of Differential Calculus.
CO4	Apply the knowledge of Differential and Integral Calculus.
CO5	Understand the fundamental relation between differential and Integral Calculus.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Calculus-I
Course Code: BSHM-101-22

UNIT-I

Functions, their limits and continuity: Real line, intervals, order properties of real numbers, the least upper bound and the greatest lower bound properties, Archimedean property. Functions, Graphs of functions, Exponential functions, Inverse functions and Logarithmic functions, implicitly defined functions, some special functions, one-one functions, onto functions, composition of functions, limit of a function, calculating limits through limit laws, limits using L' Hospital's rule, The precise definition of limit and continuity (ε-δ definition), continuous functions and classification of discontinuities, uniform continuity.

UNIT-II

Differentiation: Derivative of a function, the derivative as a function, derivatives of polynomials and exponential functions, the product and quotient rules, rates of change in natural and social sciences, derivatives of trigonometric, inverse trigonometric, logarithmic, and hyperbolic functions, the chain rule, implicit differentiation, differentiation of determinants.

UNIT-III

Applications of derivative: maximum and minimum values, increasing and decreasing functions, Intermediate value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's mean value theorem, how derivatives affect the shape of graph, concavity, convexity, the second derivative test, points of inflexion.

UNIT-IV

Higher order derivatives, calculation to the n^{th} derivative, determination of n^{th} derivative of rational functions. The n^{th} derivative of the products of power of sines and cosines, Leibnitz's theorem, the n^{th} derivative of the product of two functions, Maclaurin's theorem, Taylor's theorem.

TEXT BOOKS

1. Shanti Narayan and P. K. Mittal, Differential Calculus, S. Chand, 2015

RECOMMENDED BOOKS:

2. James Stewart, Calculus, 5th Edition, Brooks/Cole (Thomson), 2003.
3. Robert Wrede and Murray R. Spiegel, Advanced Calculus, 3rd Edition, Schaum's Outline Series (McGraw Hill), 2010.
4. Maurice D Weir, Frank R. Giordano and Joel Hass, Thomas' Calculus, 11th Edition, Pearson, 2008.
5. N. Piskunov, Differential and Integral Calculus, Mir Publishers, Moscow (CBS Publishers & Distributors, India), 1996.

BSHM-102-22	**Algebra**	**L-5, T-1, P-0**	**6 Credits**
Pre-requisite: - Complex numbers, Sets, Relation and Functions			
Course Objectives: This course is designed to introduce the basic notions of algebra. The major focus of the course will be on: De Moivre's theorem & its applications, matrices and their use in system of equations; theoretical foundation of theory of equations and their solutions.			
Course Outcomes: At the end of the course, the students will be able to			
CO1	Use the De Moivre's theorem for solving problems concerning powers of complex numbers and complex roots of polynomials etc.		
CO2	Use matrices in solving system of equations.		
CO3	Demonstrate linear independence and dependence of a set of vectors.		
CO4	Find inverse of a matrix using Gauss-Jordan method.		
CO5	Demonstrate the nature of solutions of polynomial equations and use Cardano's method, Ferrari method and Descarte's method for finding solutions of equations.		

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Algebra

Course Code: BSHM-102-22

Unit I

Polynomials and Complex Numbers: Polynomials, The remainder and factor theorem, Synthetic division, Factored form of a polynomial, Fundamental theorem of algebra, Polar representation of complex numbers, De Moivre's theorem for integer and rational indices and their applications. The nth roots of unity.

Unit II

Roots of a Polynomial: Relations between the roots and the coefficients of polynomial equations, Theorems on imaginary, integral and rational roots Fundamental theorem of symmetric polynomials (without proof). Evaluation of symmetric functions of roots, Rational roots of polynomials with integral coefficients. Descartes rule of sign.

Unit III

Cubic and Biquadratic Equations: Strum's theorem (statement only), Solution of cubic equation using Cardano's method, and biquadratic equation by Descartes method and Ferrari's method.

Unit IV

System of Equations: Systems of linear equations (homogeneous and non-homogeneous), Row reduction and echelon forms, Row rank, column rank and their equivalence, Vector equations, The matrix equation Ax = b, Solution sets of linear systems, Gauss elimination method, Consistency of Linear System of equations, Augmented matrices, The inverse of a matrix, Gauss Jordon method.

RECOMMENDED BOOKS:

- Andreescu, Titu & Andrica Dorin, Complex Numbers from A to...Z. (2nd ed.). Birkhäuser (2014).
- Dickson, Leonard Eugene First Course in the Theory of Equations. The Project Gutenberg E-Book (http://www.gutenberg.org/ebooks/29785), (2009)
- Kolman, Bernard, & Hill, David R., Introductory Linear Algebra with Applications (7th ed.). Pearson Education, Delhi. First Indian Reprint 2003.

BSHM-103-22	**Programming Lab-I**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Knowledge of basic concepts in Mathematics, such as, graphs, functions, conics, matrices etc.

Course Objectives: This course is designed to introduce the basic knowledge of computer programming t simple algebraic operations on matrices and to visualize the geometry of curves and conics. two dimensions. The major focus of this course will be on geometric definition of two-dimensional shapes and a rigorous discussion on their properties and use.

Course Outcomes: At the end of the course, the students will be able to

CO1	Explain the basic concepts of programming.
CO2	Apply the knowledge of programming in different Matrix Operations.
CO3	Use programming in plotting and visualization of graphs of algebraic and transcendental functions.
CO4	Obtain Surface of revolution of curves.
CO5	Study further the tracing of conics.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Programming Lab-I

Course Code: BSHM-103-22

The following topics to be practiced using MATLAB:

i) Introduce the programming through MATLAB
ii) Perform Matrix Operations, such as, Addition, Multiplication, inverse, Transpose etc.
iii) Plot the graphs of algebraic and transcendental functions (For example, $e^{ax+b}, \log(ax+b), \frac{1}{ax+b,}$ with constants a, b, etc.)
iv) Obtain the surface of revolution of curves.
v) Trace of conics in Cartesian Coordinates /Polar Coordinates.
vi) Applications of derivative.

RECOMMENDED BOOKS:

1. Higham, D.J. and Higham, N.J., MATLAB Guide, 2nd Edition. Society for Industrial and Applied Mathematics (SIAM), 2005.
2. Gilat, A., MATLAB: An Introduction with Applications, 5th Edition. John Wiley & Sons, 2014.

BHHL-115-22	**Communicative English**	**L-2, T-0, P-0**	**2 Credits**

Pre-requisite: Basic proficiency in Communication Skills

Course objectives:

- To help the students become proficient in LSRW-Listening, Speaking, Reading & Writing skills
- To help the students become independent users of the English language
- To develop in them vital communication skills, integral to their personal, social, and professional interactions
- To teach them the appropriate language of professional communication
- To prepare them for the job market in their respective domains of specialization.

Course Outcomes: At the end of the course, the students will

CO1	acquire basic proficiency in reading &listening, writing and speaking skills
CO2	be able to understand spoken and written English language, particularly the language of their chosen technical field.
CO3	be able to converse fluently.
CO4	be able to produce their own clear and coherent texts.
CO5	become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills and thereby will have better job prospects.

Mapping of Course Outcomes with the Program Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	-	-	-	-	✓
CO2	-	-	-	-	✓
CO3	-	-	-	-	✓
CO4	-	-	-	-	✓
CO5	-	-	-	-	✓

Course Title: Communicative English

Course Code: BHHL-115-22

UNIT I-(Literature)

(A) ***The Poetic Palette*** **(Orient Black Swan, Second Edition, 2016)**

The following poems from this anthology are prescribed:

1. Pippa's Song: Robert Browning
2. I Sit and Look Out: Walt Whitman
3. Women's Rights: Annie Louise Walker

(B) ***Prose Parables*** **(Orient Black Swan, 2013)**

The following stories from the above volume are prescribed:

1. Grief: Anton Chekov
2. The Doctor's Word: R.K. Narayan
3. The Doll's House: Katherine Mansfield

UNIT-II

Vocabulary: Synonyms, Antonyms; Standard Abbreviations; One-word substitution

Grammar: Subject-Verb Agreement; Noun- Pronoun Agreement; Use of phrases and clauses in sentences; Sentence Structures; Transformation of Sentences

UNIT-III

Reading and Understanding: Comprehension; Summarizing; Paraphrasing; Translation (from Hindi/Punjabi to English and vice-versa); Précis Writing

UNIT-IV

Mechanics of Writing & Speaking Skills: Business letters; Report writing; Career Documents- Job applications, Resume/CV writing, Conversations & Dialogues, Formal Presentations; Dynamics of Group Discussion.

Text & Reference Books:

1. John Eastwood, *Oxford Practice Grammar,* Oxford University Press, 2014.
2. Michael Swan, *Practical English Usage,* OUP, 1995
3. F.T. Wood, *Remedial English Grammar,* Macmillan, 2007.
4. William Zinsser, *On Writing Well,* Harper Resource Book, 2001.
5. Sanjay Kumar and Pushp Lata, *Communication Skills,* Oxford University Press, 2011.
6. Liz Hamp-Lyons and Ben Heasly, *Study Writing,* Cambridge University Press, 2006.

BSHP-111-21	**Optics**	**L-3, T-1, P-0**	**04 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: The objective of the course is to develop basic understanding of Interference, Diffraction and Polarization among students. They also learn about the LASER and its applications. Students will be equipped with knowledge to measure wavelength, refractive index, and other related parameters, which will act as a strong background if he/she chooses to pursue physics as a career.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in optics and other related wave phenomena
CO2	Analyze and understand coherence and phenomenon of interference and their applications
CO3	Acquainted with Fresnel's and Fraunhofer's diffraction and their applications.
CO4	Get thorough knowledge of the polarization of light, changes upon reflection and transmission and will learn to analyze the polarization in optical systems.
CO5	Describe the different types of lasers, its principle, properties and applications of laser beam.

Mapping of course outcomes with the program outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	✓	-	✓	✓
CO2	-	✓	-	✓	✓
CO3	-	✓	-	✓	✓
CO4	-	✓	-	✓	✓
CO5	-	✓	-	✓	✓

Course Title: Optics

Course Code: BSHP-111-21

PART-A

UNIT I

Interference: Definition and properties of wave front, Temporal and Spatial Coherence, Young's double slit experiment, Lloyd's single mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes), Newton's Rings: Measurement of wavelength and refractive index, Interferometer: Michelson Interferometer-(1) idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, Fabry-Perot interferometer.

UNIT-II

Diffraction: Huygens Principle, Huygens-Fresnel Diffraction theory, Fraunhofer diffraction: Single slit. Circular aperture, Rayleigh criterion of resolution, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions, Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel diffraction pattern of a straight edge and circular aperture.

PART-B

UNIT-III

Polarization: Plane polarized light, Representation of Unpolarized and Polarized light, Polarization by Reflection, Brewster's law, Malus Law, Polarization by Selective absorption by Crystals, Polarization by Scattering, Polarization by Double Refraction, Nicol Prism, Huygen's theory of Double Refraction, Polaroid, Elliptically and Circularly polarized lights, Quarter and Half wave plates.

UNIT-IV

Laser and Application: Lasers, Spontaneous emission, Stimulated absorption, Stimulated emission, Einstein coefficients, Einstein relations, Conditions for Laser actions, Population inversion, Different types of Laser Pumping mechanism: Optical Pumping, Electric Discharge and Electrical pumping, Resonators, Two, Three and Four level laser systems, Ruby laser, He-Ne gas Laser, Semiconductor laser, CO2 laser, applications of laser: Holography, Principle of Holography.

Text and Reference Books:

1. Optics: A.K. Ghatak (Tata-McGraw Hill), 1992.
2. Fundamentals of Optics: F.A. Jenkins and H.E. White (McGraw Hill), 1981.
3. A Textbook of Optics: Subrahmaniyam N. & et al., S. Chand Publishing, 2006.
4. O. Svelto: Principles of Lasers, Springer Science & Business Media, 2010.

BSHP-113-21	**Physics Lab-I**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite (If any): High-school education

Course Objectives: The aim and objective of the lab course is to introduce the students to the formal structure of electromagnetism and phenomenon of wave optics so that they can use these as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	-	✓	-	✓	✓
CO2	-	✓	-	✓	✓
CO3	-	✓	-	✓	✓
CO4	-	✓	-	✓	✓
CO5	-	✓	-	✓	✓

Course Title: Physics Lab-I

Course Code: BSHP-113-21

Note: Students are expected to perform about 8-10 experiments from the following list, selecting minimum of 6-7 from the Physical Lab and 2-3 from the Virtual lab.

List of experiments:

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the laser beam characteristics like; wavelength, aperture, spot size, etc. using diffraction grating.
3. To study the diffraction using laser beam and thus to determine the grating element.
4. To study wavelength and laser interference using Michelson's Interferometer.
5. To find the refractive index of a material/glass using spectrometer.
6. To find the refractive index of a liquid using spectrometer.
7. To determine the angle of prism and resolving power of a prism.
8. To study the magnetic field of a circular coil carrying current using a Steward and Gees Tangent Galvanometer.
9. Determine the radius of circular coil using the Circular coil.
10. To study B-H curve using CRO.
11. To find out polarizability of a dielectric substance.
12. To find out the horizontal component of earth's magnetic field (B_h).

Text and Reference Books:

1. A Textbook of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
4. Practical Physics, C L Arora. S. Chand & Company Ltd.
5. http://www.vlab.co.in

UGCA-1902	Fundamentals of Computer and IT	L-3, T-1, P-0	4 Credits
Pre-requisite: NA			
Course Outcomes: At the end of the course, the student will be able to			
CO1	Understanding the concept of input and output devices of Computers		
CO2	Learn the functional units and classify types of computers, how they process information and how individual computers interact with other computing systems and devices.		
CO3	Understand an operating system and its working, and solve common problems related to operating systems		
CO4	Learn basic word processing, Spreadsheet and Presentation Graphics Software skills.		
CO5	Study to use the Internet safely, legally, and responsibly		

Course Title: Fundamentals of Computer and IT

Course Code: UGCA-1902

UNIT-I

Human Computer Interface: Concepts of Hardware and Software; Data and Information. **Functional Units of Computer System:** CPU, registers, system bus, main memory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors.

Devices: Input and output devices (with connections and practical demo), keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter. **Memory:** Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks.

Data Representation: Bit, Byte, Binary, Decimal, Hexadecimal, and Octal Systems, Conversions and Binary Arithmetic (Addition/ Subtraction/ Multiplication) Applications of IT.

UNIT II

Concept of Computing, Types of Languages: Machine, assembly and High-level Language; Operating system as user interface, utility programs.

Word processing: Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge, equation editors.

UNIT-III

Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs.

Presentation Graphics Software: Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.

UNIT-IV

Electronic Payment System: Secure Electronic Transaction, Types of Payment System: Digital Cash, Electronic Cheque, Smart Card, Credit/Debit Card E-Money, Bit Coins and Crypto currency, Electronic Fund Transfer (EFT), Unified Payment Interface (UPI), Immediate Payment System (IMPS), Digital Signature and Certification Authority. Introduction to Bluetooth, Cloud Computing, Big Data, Data Mining, Mobile Computing and Embedded Systems and Internet of Things (IoT)

RECOMMENDED BOOKS:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2. A. Goel, Computer Fundamentals, Pearson Education, 2010.
3. P. K. Sinha & P. Sinha, Fundamentals of Computers, BPB Publishers, 2007.
4. R.K. Jain, IT Tools, Khanna Publishing House.
5. Satish Jain, Ambrish Rai & Shashi Singh, Introduction to Information Technology, Paperback Edition, BPB Publications, 2014.
6. www.sakshat.ac.in
7. https://swayam.gov.in/course/4067-computer-fundamentals

UGCA-1906	**Fundamentals of Computer and IT Laboratory**	**L-0, T-0, P-4**	**2 Credits**
Pre-requisite (If any): NA			
CO1	Familiarizing with Open Office (Word processing, Spreadsheets and Presentation).		
CO2	To acquire knowledge on editor, spread sheet and presentation software.		
CO3	The students will be able to perform documentation and accounting operations.		
CO4	Students can learn how to perform presentation skills.		

Course Title: Fundamentals of Computer and IT (Laboratory)

Course Code: UGCA-1906

List of experiments:

- **Word Orientation:** The instructor needs to give an overview of word processor. Details of the four tasks and features that would be covered Using word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.

    1) Using word to create Resume:
    Features to be covered: Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.
    2) Creating an Assignment
    Features to be covered: Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.
    3) Creating a Newsletter
    Features to be covered: Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs
    4) Creating a Feedback form
    Features to be covered: Forms, Text Fields, Inserting objects, Mail Merge in Word.

- **Excel Orientation:** The instructor needs to tell the importance of Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered Excel - Accessing, overview of toolbars, saving excel files.

    1) Creating a Scheduler
    Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text
    2) Creating an Assignment
    Features to be covered: Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.
    3) Creating a Newsletter
    Features to be covered: Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs

4) Creating a Feedback form
   Features to be covered: Forms, Text Fields, Inserting objects, Mail Merge in Word.

- **Presentation Orientation:**
  1) Students will be working on basic power point utilities and tools which help them create basic power point presentation.
     Topic covered includes: PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows
  2) This session helps students in making their presentations interactive.
     Topics covered include: Hyperlinks, Inserting–Images, ClipArt, Audio, Video, Objects, Tables and Charts
  3) Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation.
     Topics covered includes: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes, etc), Inserting – Background, textures, Design Templates, Hidden slides, Auto content wizard, Slide Transition, Custom
  4) Animation, Auto Rehearsing
  5) Power point test would be conducted. Students will be given model power point presentation which needs to be replicated

- **Internet and its Applications:** The instructor needs to tell the how to configure Web Browser and to use search engines by defining search criteria using Search Engines
  1) To learn to setup an e-mail account and send and receive e-mails.
  2) Tolearntosubscribe/postonablogandtousetorrentsforacceleratedddownloads.
  3) Hands on experience in online banking and making an online payment for any domestic bill.

RECOMMENDED BOOKS:

1. R.K. Jain, IT Tools, Khanna Publishing House.
2. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
3. Turban, Rainer and Potter, Introduction to information technology, John Wiley and Sons.
4. Joseph Brady & Ellen F Monk, Problem Solving Cases in Microsoft Excel, Thomson Learning.

SEMESTER-II

BSHM-201-22	**Real Analysis**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Elementary calculus

Course Objectives: The objectives of this course are to make the students understand the fundamental concepts of Real line and its property. Students will understand the bounded, unbounded and limit suprema and infima. They will use monotone convergence theorem for the calculation of square roots.They observe theconvergent and divergent sequences.They can apply various teststo check the convergence or divergence of sequences and series.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic concepts of Real line and its property.
CO2	Understand the bounded, unbounded and limit suprema and infima.
CO3	Use of monotone convergence theorem for the calculation of square roots.
CO4	Check the convergence and divergence sequences and infinite series.
CO5	Apply the knowledge of various test to establish the convergence and divergence sequences and infinite series.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Real Analysis
Course Code: BSHM-201-22

UNIT-I

Real Numbers: Field and order structure of R, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Supremum and Infimum.

UNIT-II

Completeness of $\mathbb{R}$: Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Closed sets, Countable and Uncountable sets.

UNIT-III

Sequences: Sequences, Limit points of a sequence, Limit Inferior and Superior, Convergent Sequences, Non convergent sequences (Definitions), Cauchy's sequence, Cauchy's General Principle of Convergence, Algebra of sequences, Some Important Theorem, [Ref. Text Book 1], Monotonic sequences.

UNIT-IV

Infinite Series: Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, D'Alembert's Ratio Test, Rabb's. Gauss and Logrithmic test (Statement of these three tests only). Cauchy's Root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

TEXT BOOKS:

1. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International (P) Ltd., New Delhi, 2017.

RECOMMENDED BOOKS:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.

BSHM-202-22	Differential Equations	L-4, T-0, P-0	4 Credits

Pre-requisite: - Functions, Differentiation, Integration.

Course Objectives: The Objective of this course is to introduce ordinary differential equations and basic theory ofexistence and uniqueness of solutions. This course further explains the analytic techniques incomputing the solutions of various ordinary differential equations appearing in various fields ofscience and technology.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic definitions to know about ordinary differential equations, its various types and their solutions.
CO2	Visualize the geometrical meaning of first order differential equation.
CO3	Understand the fundamental concepts about existence and uniqueness of solution ofinitial value problem.
CO4	Understand the applications of differential equations in different type of Phenomenon.
CO5	Apply power series method to obtain series solutions of differential equations.

Mapping of course outcomes with the program outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Differential Equations

Course Code: BSHM-202-22

Unit I

Differential equations: General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, Cauchy's linear equation and Bernoulli equations.

Unit II

Mathematical models (Linear Models): 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.

Unit III

Higher Order Linear Differential Equations: 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, Euler's equation, method of undetermined coefficients, method of variation of parameters.

Unit IV

Mathematical Models (Non-linear Models): Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

TEXT BOOKS:

1. J. N. Kapur,, Mathematical Modelling, 1st Ed., New Age International (P) Ltd.,, New Delhi, 2021.
2. Shanti Narayan, Differential Equations and it's Applications,

RECOMMENDED BOOKS:

1. Belinda Barnes and Glenn R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and MATLAB, 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India, 2005.
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.

BSHM-203-22	**Programming Lab-II**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Knowledge of basic concepts in Differential equations and Real analysis, such as, ODE, Order, Degree, Linear Differential Equations, sequence, series, limit point, convergence, divergence, etc.

Course Objectives: This course is designed to introduce the basic knowledge of computer programming to simple differential equations and to visualize the convergence and divergence of sequences and series. The major focus of this course will be on understanding the mathematical models behind a real-life situation.

Course Outcomes: At the end of the course, the students will be able to

CO1	Explain the basic concepts of MATLAB and Mathematica.
CO2	Apply the knowledge of programming in different Differential equations.
CO3	Use programming in plotting the solution and visualization of growth and decay mathematical models.
CO4	Plotting the recursive sequences and study the convergence of sequences through plotting.
CO5	Study the convergence/divergence of infinite series

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Programming Lab-II

Course Code: BSHM-203-22

The following topics to be practiced using any software:

vii) Introduce the programming through MATLAB and MATHEMATICA
viii) Plotting of second order solution family of differential equation.
ix) Plotting of third order solution family of differential equation.
x) Growth model (exponential case only).
xi) Decay model (exponential case only).
xii) Plotting of recursive sequences.
xiii) Study the convergence of sequences through plotting.
xiv) Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
xv) Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
xvi) Cauchy's root test by plotting nth roots.
xvii) Ratio test by plotting the ratio of nth and (n+1)th term.

RECOMMENDED BOOKS:

1. Gilat, A., MATLAB: An Introduction with Applications, 5th Edition. John Wiley & Sons, 2014.
2. Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.

ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ

BHHL-116A-22

ਬੈਚੂਲਰ ਆਫ ਸਾਇੰਸ

(ਸਲੇਬਸ) ਸਮੈਸਟਰ -ਦੂਜਾ

Credit-2-0-0

ਯੂਨਿਟ-1

ਕਵਿਤਾ ਭਾਗ:

ਭਾਈ ਵੀਰ ਸਿੰਘ: ਚਸ਼ਮਾ

ਪ੍ਰੋ.ਪੂਰਨ ਸਿੰਘ : ਹੱਲ ਵਾਹੁਣ ਵਾਲੇ

ਪ੍ਰੋ.ਮੋਹਨ ਸਿੰਘ : ਕੋਈ ਆਇਆ ਸਾਡੇ ਵਿਹੜੇ

ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ: ਅੰਨਦਾਤਾ

ਡਾ.ਹਰਿਭਜਨ ਸਿੰਘ: ਤੇਰੇ ਹਜ਼ੂਰ ਮੇਰੀ ਹਾਜ਼ਰੀ ਦੀ ਦਾਸਤਾਨ

ਸ਼ਿਵ ਕੁਮਾਰ ਬਟਾਲਵੀ: ਕੰਡਿਆਲੀ ਥੋਰ੍ਹ

ਪਾਸ਼: ਇਨਕਾਰ

ਸੁਰਜੀਤ ਪਾਤਰ: ਹੁਣ ਘਰਾਂ ਨੂੰ ਪਰਤਣਾ

ਕਹਾਣੀ ਭਾਗ:

ਸੁਜਾਨ ਸਿੰਘ :ਕੁਲਫੀ

ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ : ਤੂੜੀ ਦੀ ਪੰਡ

ਗੁਰਦਿਆਲ ਸਿੰਘ : ਸਾਂਝ

ਸੰਤੋਖ ਸਿੰਘ ਧੀਰ: ਕੋਈ ਇਕ ਸਵਾਰ

ਮੋਹਨ ਭੰਡਾਰੀ :ਘੋਟਣਾ

ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ : ਆਪਣਾ ਆਪਣਾ ਹਿੱਸਾ

ਯੂਨਿਟ-2 (ਭਾਸ਼ਾ ਤੇ ਲਿਪੀ)

ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਤੇ ਉਪ-ਭਾਸ਼ਾ ਵਿਚ ਅੰਤਰ, ਪੰਜਾਬੀ ਦੀਆਂ ਉਪ-ਭਾਸ਼ਾਵਾਂ

ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਉਪਰ ਪਏ ਪ੍ਰਭਾਵ

ਭਾਸ਼ਾ ਤੇ ਲਿਪੀ, ਗੁਰਮੁਖੀ ਲਿਪੀ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ

ਯੂਨਿਟ-3 (ਲੇਖਣੀ-ਕਲਾ)

ਪੈਰ੍ਹਾ ਰਚਨਾ

ਅਨੁਵਾਦ: ਅੰਗਰੇਜ਼ੀ ਤੋਂ ਪੰਜਾਬੀ, ਪੰਜਾਬੀ ਤੋਂ ਅੰਗਰੇਜ਼ੀ

ਦਫਤਰੀ ਚਿੱਠੀ ਪੱਤਰ

ਸਾਹਿਤ ਦੇ ਰੰਗ (ਸੰਪ.ਡਾ.ਮਹਿਲ ਸਿੰਘ),ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ,ਪਹਿਲੀ ਵਾਰ, 2016.

ਮੁਢਲੀ ਪੰਜਾਬੀ

BHHL-116B-22

ਬੈਚੂਲਰ ਆਫ ਸਾਇੰਸ

(ਸਲੇਬਸ) ਸਮੈਸਟਰ -ਦੂਜਾ

Credit-2-0-0

ਯੂਨਿਟ-1

ਪੈਂਤੀ ਅੱਖਰੀ (ਵਰਣਮਾਲਾ), ਅੱਖਰ ਕ੍ਰਮ

ਮਾਤਰਾਵਾਂ : ਮੁਢਲੀ ਜਾਣ-ਪਛਾਣ

ਲਗਾਖਰ :ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ

ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ: ਮੁਢਲੀ ਜਾਣ-ਪਛਾਣ

ਮੂਲ ਸ਼ਬਦ , ਅਗੇਤਰ, ਪਿਛੇਤਰ

ਸਮਾਨਾਰਥਕ ਸ਼ਬਦ, ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ

ਸ਼ੁੱਧ- ਅਸ਼ੁੱਧ: ਦਿੱਤੇ ਪੈਰ੍ਹੇ ਵਿੱਚੋਂ ਅਸ਼ੁੱਧ ਸ਼ਬਦ ਨੂੰ ਸ਼ੁੱਧ ਕਰਨਾ

ਯੂਨਿਟ-2

ਹਫਤੇ ਦੇ ਸੱਤ ਦਿਨਾਂ ਦੇ ਨਾਂ

ਬਾਰ੍ਹਾਂ ਮਹੀਨਿਆਂ ਦੇ ਨਾਂ

ਰੁੱਤਾਂ ਦੇ ਨਾਂ

ਇਕ ਸੌ ਤੱਕ ਗਿਣਤੀ ਸ਼ਬਦਾਂ ਵਿਚ

ਰੋਜ਼ਾਨਾ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ:

ਬਾਜ਼ਾਰ, ਵਪਾਰ,ਰਿਸ਼ਤੇ-ਨਾਤੇ ਤੇ ਕਿੱਤਿਆਂ ਸਬੰਧੀ।

ਯੂਨਿਟ-3

ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਪਛਾਣ ਤੇ ਵਰਤੋਂ-

ਨਾਂਵ, ਪੜਨਾਂਵ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ

ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ :

ਸਧਾਰਣ ਵਾਕ

ਸੰਯੁਕਤ ਵਾਕ

ਮਿਸ਼ਰਤ ਵਾਕ

BHIC-111-22	**CHEMISTRY-I**	L-3, T-1, P-0	**Credits:4**

Prerequisite: Subject knowledge of senior secondary level

Objective(s):	1. To teach the fundamental concepts of Inorganic Chemistry and chemical bonding. 2. To teach the basic principles, chemical reaction and reaction mechanisms of organic compounds.

At the end of the course, the student will be able to

CO1. Understand the fundamental concepts and postulates of various theories regarding the structure of atom

CO2. Learn about the various theories pertaining to the different types of bonding

CO3. Understand the fundamental concepts of organic chemistry i.e structure, bonding and various effects in organic compounds

CO4. To study the various known reactive intermediate in organic synthesis

CO5. To learn the fundamental and advanced concepts of reaction mechanisms along with the study of reaction mechanisms in various types of substitution addition and elimination reactions

Mapping of course outcomes with the program outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	-	-	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	-	✓	✓	✓	✓
CO5	-	✓	✓	✓	✓

Course Title: Chemistry-I
Course Code: BHIC-111-22

Unit-I

Atomic Structure: Bohr's theory and its limitations and atomic spectrum of hydrogen atom. Wave mechanics: deBroglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s, p, d* and *f* orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations.

Chemical Bonding-I: Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations, Packing of ions in crystals, Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application.

Unit-II

Chemical Bonding-II: Covalent bond: Lewis structure, Valence Bond theory (Heitler London approach), Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO NO, and their ions.

Unit-III

Basics of Organic Chemistry Organic Compounds:
Classification, and Nomenclature, Hybridization, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyper conjugation and their applications; Dipole moment; Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Chemistry of Aliphatic Hydrocarbons-I:
Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Unit-IV

Chemistry of Aliphatic Hydrocarbons-II:
Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical).

Aromatic Hydrocarbons Aromaticity:
Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism.

Reference Books

1 Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2 Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999
3 Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994
4 Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5 Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)

BHIC-112-22	**Chemistry Lab-I**	L-0, T-0, P-4	Credits: 02
Pre-requisite: Understanding of senior secondary level Chemistry			
Course Objectives: The objective of this course is to provide practical knowledge and illustrative experiments about various types of inorganic titrations and general organic techniques			
Course Outcomes: At the end of the course, the students will be able to			
CO1	Learn the quantitative analysis of various metal ions/cations and anions.		
CO2	Understand the various principles of different techniques involved in the quantitative analysis.		
CO3	Learn the basic qualitative techniques		
CO4	Learn chromatographic techniques for the identification and separation of compounds		
CO5	Learn about the applications of basic techniques		

Mapping of course outcomes with the program outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Chemistry Lab-I
Course Code: BHIC-112-22

Part-I

(A) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

(B) **Oxidation-Reduction Titrations**

(i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Part-II

(i) Checking the calibration of the thermometer
(ii) Purification of organic compounds by crystallization using the following solvents: a) Water b) Alcohol, and c) Alcohol-Water.
(iii) Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
(iv) Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
(v) Determination of boiling point of liquid compounds. (boiling point lower than and more than 100°C by distillation and capillary method)
(vi) Chromatography a) Separation of a mixture of two amino acids by ascending and horizontal paper chromatography b) Separation of a mixture of two sugars by ascending paper chromatography, c) Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

BBA-GE 201-18	**Managerial Economics II**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Understanding of basic knowledge of Managerial Economics

Course Objectives: This course aims to acquaint students with economy as a whole including measurement of national income, inflation and unemployment, which an objective to inculcate understanding of macroeconomic environment of an economy for better decision making.

Course Outcomes: After completion of the course, the students shall be able to:

CO1	Explain the concept of national income and its measurement using different approaches.
CO2	Describe the underlying theories of demand and supply of money in an economy.
CO3	Make use of employment and national income statistics students will be able to describe and analyze the economy in quantitative terms.
CO4	Interpret macroeconomic issues like money, inflation and unemployment.
CO5	Identify the phases of the business cycle and the problems caused by cyclical fluctuations in the market economy

Mapping of course outcomes with the program outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	✓	-	-	✓
CO2	-	✓	-	-	✓
CO3	-	✓	-	-	✓
CO4	-	✓	-	-	✓
CO5	-	✓	-	-	✓

Course Title: Managerial Economics II

Course Code: BBAGE 201-18

UNIT-I

National Income: Measuring National Income. Problems in the measurement of National Income. Theories of Money: Nature and functions of money – Types of money: Near money, inside money and outside money. Theories of demand for money – defining demand for money – Classical theories of demand for money – Friedman's re-statement of Quantity Theory of

Money; Liquidity preference theory and Keynesian Liquidity Trap. Theories of Supply of money; Defining supply of money; Measuring supply of money.

UNIT-II

Theories of Inflation and Unemployment: Meaning, Types and Theories of Inflation. - Cost of inflation and sacrifice ratio. - Measurement of Inflation in India - Policies to control inflation Meaning and types of unemployment. - Cost of unemployment and Oakun's Law Measurement of unemployment in India. - Concept of Stagflation - Concept of Philips Curve.

Unit-III

Business cycle: Meaning, types and phases. Monetary, Fiscal and Income policy – Meaning and instruments. Multiplier: Concept, Features and Leakages. Foreign trade multiplier.

Unit-IV

Macro-economic Framework in Indian Economy–Public Finance–Tax system in India– Financial Administration: Finance Commission.

RECOMMENDED BOOKS:

1. Ahuja, H.L.(2015) Macroeconomics-Theory and Policy. New Delhi: Sultan Chand.

2. Jhingan, M.L. (2016) Macro Economic Theory. Delhi: Vrinda Publications Pvt. Ltd

3. Dwivedi, D.N.(2017)Macroeconomics: Theory and Practice: Theory & Practice. New Delhi: McGraw Hill.

4. Jain, T.R., Khanna, O.P.(2014) Managerial Economics: V.K. Publications

5. Dewett, K.K., Navalur, M.H., (2006) Modern Economic Theory: New Delhi: Sultan Chand.

SEMESTER-III

BSHM-301-22	**Theory of Real Functions**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Sequences and Series

Course Objectives: The objectives of this course are to:

1. Introduce basic concepts of theory of real functions from theoretical point of view and also to explore important applications.
2. Develop analytical and computational skills of students.
3. Introduce sequential criterion for limits and continuity.
4. Discuss derivative and its applications.
5. Introduce Taylor's theorem with its different forms of remainder and also to explore its various applications.
6. Introduce Fourier series representation of certain functions.

Course Outcomes: At the end of the course, the students will be able to

CO1	Deal with the basic concepts of real analysis rigorously.
CO2	Use the concepts of limit, continuity and derivative in different fields of study.
CO3	Apply Taylor series in approximating functions, deal with certain inequalities and convex function.
CO4	Understand different forms of remainder term of Taylor series and also to utilize these remainder terms to assess the error in approximations.
CO5	Expand certain functions in terms of Fourier series.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Theory of Real Functions
Course Code: BSHM-301-22

UNIT-I

Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity, discontinuity criterion. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. (Scope: Section 4.1, 4.2, 4.3, 5.1,5.2, 5.3 of Textbook: Bartle et al. [1]).

UNIT-II

Uniform continuity, non-uniform continuity criteria, uniform continuity theorem, Lipschitz condition, continuous extension theorem, Weierstrass approximation theorem (without proof), Differentiability of a function at a point and in an interval, Caratheodory's theorem, Chain rule, Darboux's theorem. (Scope: Section 5.4.1-5.4.8, 6.1, 6.2.12 of Textbook: Bartle et al. [1]).

UNIT-III

Taylor polynomial, Taylor's theorem, estimate of error in approximating a function, convex function, application of Taylor theorem to inequalities and convex functions. (Scope: Section 6.4.1, 6.4.2,6.4.3, 6.4.5, 6.4.6 of Textbook: Bartle et al. [1]).

Inner product of functions, orthogonal functions, orthogonal set of functions, orthonormal set of functions, periodic functions, piecewise continuous function, even and odd functions. (Scope: Section 12.1 of Textbook: Zill [2]).

UNIT-IV

Trigonometric series, Fourier series, sufficient conditions for convergence of a Fourier series, sequence of partial sums of Fourier series, Fourier cosine series, Fourier sine series, Gibbs phenomenon, half range expansions. (Scope: Section 12.2,12.3 of Textbook: Zill [2]).

TEXT BOOKS

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
2. Dennis G. Zill, Advanced Engineering Mathematics, 6th Edition, Jones and Bartlett

   Publishers, 2016.
3. Shanti Narayan, M. D. Raisinghania, Elements of Real Analysis, 14th Revised Edition, S. Chand & Company LTD, New Delhi, 2013.

RECOMMENDED BOOKS:

1. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
2. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
3. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

BSHM-302-22	**Group Theory I**	**L-5, T-1, P-0**	**6 Credits**
Pre-requisite: Set Theory			
Course Objectives: The main aim of the course is to introduce the students to basic concepts from abstract algebra, especially the notion of a group. The course will help prepare you for further study in abstract algebra as well as familiarize you with tools essential in many other areas of mathematics. The other aim of this course is to provide the learner with the skills, knowledge and competencies to carry out their duties and responsibilities in a pure Mathematical environment.			
Course Outcomes: At the end of the course, the students will be able to			
CO1	learn the basic concepts like groups, subgroups, cyclic groups, normal subgroups, homomorphisms, etc.		
CO2	learn about binary operations on algebraic structures which are quite significant in modern mathematics.		
CO3	understand the theorems of group isomorphisms and isomorphisms.		
CO4	be acquainted with prerequisite knowledge required to learn advanced algebra.		
CO5	apply the learnt techniques in modern algebra.		

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Group Theory I
Course Code: BSHM-302-22

UNIT-I

Groups: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

UNIT-II

Subgroups: Subgroups and examples of subgroups, properties of subgroups, centralizer, center of a group, product of two subgroups, inverse of a subset of a group.

Cosets: Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, Euler's ϕ-function.

UNIT-III

Cyclic groups: Properties of cyclic groups, subgroups of cyclic groups, generators of cyclic group, important theorem on cyclic groups.

Normal Subgroups: Normal subgroups and their properties, examples of normal subgroups, product of two normal subgroups, normalizer of a subset of a group, quotient groups.

UNIT-IV

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

Text Book:

1. V. Khanna and S.K. Bhambari, Abstract Algebra, 5th Ed., Vikas Publishing House, New Delhi, 2016.

Books Recommended:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
4. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

BSHM-303-22	**Multivariable Calculus**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Sets, Binary operations

Course Objectives: The main aim of the course is to introduce the students to the basic concepts of several variable functions, limit, continuity, differentiability, partial derivatives, gradient, divergence, curl, multiple integrals. They will be able to apply the acquired knowledge to find center of mass, volume of solids, areas of surfaces etc.

Course Outcomes: At the end of the course, the students will be able to

CO1	learn the basic concepts like several variable functions, limit continuity, differentiability, partial derivatives, etc.
CO2	learn about Lagrange multiplier method.
CO3	understand the concept of the directional derivatives, curl, divergence, gradient, etc.
CO4	be acquainted with the properties of multiple integrals, change of coordinates to polar coordinates.
CO5	apply the learnt techniques to find center of mass, volume of solids, areas of surfaces, etc

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Use of Scientific calculator is allowed.

Course Title: Multivariable Calculus
Course Code: BSHM-303-22

UNIT-I

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems.

UNIT-II

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-III

Definition of vector field, divergence and curl, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, line integrals, applications of line integrals.

UNIT-IV

Green's theorem, Stoke's theorem, Divergence theorem, their applications.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus*, Springer (SIE), Indian reprint, 2005.
4. James Stewart, *Multivariable Calculus, Concepts and Contexts*, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

BSHM-304-22	**Logic and Sets**	**L-2, T-0, P-0**	**2 Credits**

Pre-requisite: Sets, Binary operations

Course Objectives: The main aim of the course is to introduce the students to basic concepts from sets and logical operations. The course will help prepare the student to understand the relations between sets regarding membership, equality, subset, and proper subset, using proper notation. Perform the operations of union, intersection, complement, and difference on sets using proper notation.

Course Outcomes: At the end of the course, the students will be able to

CO1	learn the basic concepts like propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, etc.
CO2	learn about Propositional equivalence**,** Logical equivalences, Predicates and quantifiers**,** Binding variables and Negations.
CO3	understand the concept of sets, subsets, set operations and the laws of set theory and Venn diagrams.
CO4	be acquainted with the properties of product set, Composition of relations, Types of relations, Partitions, Equivalence Relations
CO5	apply the learnt techniques in computer algebra.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Logic and Sets
Course Code: BSHM-304-22

UNIT-I

Logic and Sets: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence**,** Logical equivalences.
Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

UNIT-II

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. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.
Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-ary relations.

Books Recommended:

1. R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
2. P.R. Halmos, Naive Set Theory, Springer, 1974. 3. E. Kamke, Theory of Sets, Dover Publishers, 1950.

PHYSICS-C-6	**BSHP-212-21**	**Elements of modern physics**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: The course content covers foundations of modern physics, experiments forming basis of quantum mechanics, Schrodinger equation and applications, uncertainty principle and applications. The topics covered in the course build a foundation of undergraduate physics students to study the advance branches: quantum physics, nuclear physics, particle physics and high energy physics.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the implication of special theory of relativity.
CO2	Understand and explain the differences between classical and quantum mechanics.
CO3	Identify properties of the nucleus and other sub-atomic particles.
CO4	Assess whether a solution to a given problem is physically reasonable and solve Schrodinger equation for simple potentials.
CO5	Describe theories explaining the structure of atoms and the origin of the observed spectra.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PSO5
CO1	-	✓	-	-	✓
CO2	-	✓	-	-	✓
CO3	-	✓	-	-	✓
CO4	-	✓	-	-	✓
CO5	-	✓	-	-	✓

Detailed Syllabus:

PART-A

UNIT -I

Special Theory of Relativity: Michelson-Morley Experiment and its outcome, Postulates of Special Theory of Relativity, Lorentz Transformations. Simultaneity and order of events, Lorentz contraction, Time dilation. Relativistic transformation of velocity, frequency, and wave number. Relativistic addition of velocities. Variation of mass with velocity, Massless Particles, Mass-energy Equivalence. Relativistic Doppler effect, Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Four Vector. **(10 Lectures)**

UNIT-II

Particle Properties of Waves: Electromagnetic waves, Blackbody Radiation, ultraviolet catastrophe, Rayleigh-Jeans formula, Planck radiation hypothesis, Photoelectric Effect, Compton Scattering, Quantum theory of light: wave and particle nature, X-Rays, X-Ray Diffraction, determination of wavelengths using Compton Effect, Pair-Production. **(10 Lectures)**

PART-B

UNIT-III

Dual Nature of Waves and Particles: Waves of probability, Description of a Waves in general, Group and Phase velocities and relation between them, De Broglie wavelength, wave-particle duality, Matter waves, Davisson-Germer experiment, Two-Slit experiment with electrons, gamma ray microscope thought experiment, Heisenberg uncertainty principle: Derivation and applications- impossibility of a particle following a trajectory, estimating minimum energy of a confined particle; Energy-time uncertainty principle-application to virtual particles and range of interaction.

(10 Lectures)

UNIT-IV

Introduction to Quantum mechanics: Need for Quantum mechanics, Wave description of particles by wave packets, Physical interpretation of a wave function: Born interpretation, probabilities, and normalization time-dependent and time-independent Schrodinger equation for wave function, Solution of stationary-state Schrodinger equation for one dimensional problem: particle in a box. **(10 Lectures)**

Text and Reference Books:

1. 1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
3. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill.
4. Physics for Scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill.
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan.
7. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
8. Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
9. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
10. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
11. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill.

PHYSICS-C	**BSHP-213-21**	**PHYSICS LAB-III**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The laboratory experiments forming basis of quantum mechanics, photoelectric effect, ionization potential, absorption and emission spectra, diffraction, and tunneling effect.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PSO5
CO1	-	✓	-	-	✓
CO2	-	✓	-	-	✓
CO3	-	✓	-	-	✓
CO4	-	✓	-	-	✓
CO5	-	✓	-	-	✓

Detailed Syllabus:

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

List of experiment:

1. Measurement of Planck's constant using black body radiation and photo-detector.
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photoelectrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine (i) wavelength and (ii) angular spread of a laser using plane diffraction grating.
12. Dependence of scattering angle on kinetic energy and impact parameter in Rutherford scattering (mechanical analogue).
13. Measurement of the electrical and thermal conductivity of copper to determine its Lorentz number.
14. To determine energy band gap of a given semiconductor.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.

UGCA-1914	**Programming in Python**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisite: NA

Course Objectives: The main aim of the course is to introduce the students to basic concepts from Python.

Course Outcomes: At the end of the course, the students will be able to

CO1	Familiar with Python environment, data types, operators used in Python.
CO2	Compare and contrast Python with other programming languages.
CO3	Learn the use of control structures and numerous native data types with their methods.
CO4	Design user defined functions, modules, and packages and exception handling methods.
CO5	Create and handle files in Python and learn Object Oriented Programming Concepts.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Programming in Python
Course Code: UGCA-1914

UNIT-I

Introduction to Python Programming Language: Programming Language, History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, Getting, Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program, Python Interactive Help Feature, Python differences from other languages. Python Data Types & Input/Output: Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command. Operators and Expressions: Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators. (12)

UNIT-II

Control Structures: Decision making statements, Python loops, Python control statements. Python Native Data Types: Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings (in detail with their methods and operations). (10)

UNIT-III

Python Functions: Functions, Advantages of Functions, Built-in Functions, User defined functions, Anonymous functions, Pass by value Vs. Pass by Reference, Recursion, Scope and Lifetime of Variables. Python Modules: Module definition, Need of modules, Creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages. (12)

UNIT-IV

Exception Handling: Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python. File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python. (10)

Classes and Objects: The concept of OOPS in Python, Designing classes, Creating objects, Accessing attributes, Editing class attributes, Built-in class attributes, Garbage collection, Destroying objects.

Text Books:

1. Pooja Sharma, Programming in Python, BPB Publications, 2017. 2. R. Nageswara Rao, Core Python Programming, 2nd Edition, Dreamtech.

Recommended Books:

1. Martin C. Brown, Python, The complete Reference, Mc Graw Hill Education.
2. A. Martelli, A. Ravenscroft and S. Holden, Python in a Nutshell, OREILLY.

Course Title: Programming in Python (Laboratory)

Course Code: UGCA-1917

List of Assignments:

1.	Compute sum, subtraction, multiplication, division and exponent of given variables input by the user.
2.	Compute area of following shapes: circle, rectangle, triangle, square, trapezoid and parallelogram.
3.	Compute volume of following 3D shapes: cube, cylinder, cone and sphere.
4.	Compute and print roots of quadratic equation $ax^2+bx+c=0$, where the values of a, b, and c are input by the user.
5.	Print numbers up to N which are not divisible by 3, 6, 9, e.g., 1, 2, 4, 5, 7,…
6.	Write a program to determine whether a triangle is isosceles or not?
7.	Print multiplication table of a number input by the user.
8.	Compute sum of natural numbers from one to n number.
9.	Print Fibonacci series up to n numbers e.g. 0 1 1 2 3 5 8 13…..n
10.	Compute factorial of a given number.
11.	Count occurrence of a digit 5 in a given integer number input by the user.
12.	Print Geometric and Harmonic means of a series input by the user.
13.	Evaluate the following expressions: a. $x-x^2/2!+x^3/3!-x^4/4!+\dots x^n/n!$ b. $x-x^3/3!+x^5/5!-x^7/7!+\dots x^n/n!$
14.	Print all possible combinations of 4, 5, and 6.
15.	Determine prime numbers within a specific range.
16.	Count number of persons of age above 60 and below 90.
17.	Compute transpose of a matrix.
18.	Perform following operations on two matrices. 1) Addition 2) Subtraction 3) Multiplication
19.	Count occurrence of vowels.
20.	Count total number of vowels in a word.

Text Books:

1. Programming in Python, Pooja Sharma, BPB Publications, 2017.
2. Core Python Programming, R. Nageswara Rao, 2nd Ediiton, Dreamtech.

Reference Books:

1. Python, The complete Reference, Martin C. Brown, Mc Graw Hill Education.
2. Python in a Nutshell, A. Martelli, A. Ravenscroft, S. Holden, OREILLY

SEMESTER-IV

BSHM-401-22	**Numerical Methods**	**L-4, T-0, P-0**	**4 Credits**

Pre-requisite: Differential and Integral Calculus

Course Objectives: The objectives of this course are to:

1. Introduce numerical methods for solving continuous problems which are difficult to deal with analytically.
2. Develop analytical and computational skills of students.
3. Introduce methods to deal with nonlinear equations, system of linear algebraic equations.
4. Introduce methods for constructing interpolating polynomials.
5. Introduce methods to deal with numerical differentiation, numerical integration and ordinary differential equations.
6. Develop understating of computational mathematics and also to demonstrate its importance in science and engineering.

Course Outcomes: At the end of the course, the students will be able to

CO1	Find approximate numerical solutions of nonlinear equations and system of linear algebraic equations.
CO2	Develop and use interpolating polynomials when explicit form of the function of interest is not known or complicated to deal with.
CO3	Deal with differentiation and definite integral problems approximately when it is difficult to get exact evaluation of these.
CO4	Apply the numerical methods for solving ordinary differential equations when it is difficult to deal with them analytically.
CO5	Apply the understanding of computational techniques in dealing with real world problems occurring in science and engineering.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Numerical Methods
Course Code: BSHM-401-22

UNIT-I

Computer representation of numbers, scientific notation, accuracy of numbers, errors and its different types, estimation of errors, propagation of errors, the concepts of stability and condition number. Algorithms and convergence.

Polynomial and transcendental equations: Bisection method, Newton-Raphson's method, Secant method, Regula-Falsi method, General iteration method, Rate of convergence.

UNIT-II

System of linear algebraic equations, Gaussian elimination method, Gauss-Jordan method. Iterative methods: Gauss Jacobi method, Gauss-Seidel method and their convergence analysis.

Interpolation, Lagrange interpolation, Newton's divided difference interpolation, Gregory-Newton's forward and Gregory-Newton's backward difference interpolation formulas, Error in interpolation.

UNIT-III

Numerical differentiation: methods based on finite differences. Numerical integration: Midpoint rule, Trapezoidal rule, Simpson's rule, Simpson's $\frac{3}{8}$-rule, Boole's rule, composite Trapezoidal rule, composite Simpson's rule.

UNIT-IV

Ordinary differential equations, Taylor series method, Euler's methods, Runge-Kutta methods, linear multi-step methods: Adams-Bashforth methods, Adams-Moulton methods and Milne-Simpson's method.

TEXT BOOKS

1. M. K. Jain. S. R.K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, 7th Ed., 2019.
2. Richard L. Burden and J. Douglas Faires, Numerical Analysis, 9th Edition, Cengage Learning, 2012.

RECOMMENDED BOOKS:

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, 2007.
2. K. E. Atkinson, An Introduction to Numerical Analysis, 2nd Ed., Wiley, 1989.
3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
4. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

BSHM-402-22	**Riemann Integration and Series of Functions**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Functions, limit, continuity, differentiability, integrability, sequence and series

Course Objectives: The objectives of this course are to make the students understand the following:

1. Riemann integration and their basic properties, Fundamental theorems of Calculus.
2. Pointwise and uniform convergence of sequence of functions
3. Series and infinite series of functions.
4. Tests for uniform convergence of a series.

Course Outcomes: At the end of the course, the students will be able to

CO1	Define Riemann Stieltjes integral and illustrate the properties of integration and differentiation
CO2	Acquire the knowledge of sequence and series.
CO3	Have the knowledge of uniformly convergence of series by different Test.
CO4	Apply the differentiation to find out the maximum and minimum value of functions.
CO5	To understand the statement and prove of important theorems.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Riemann Integration and Series of Functions
Course Code: BSHM-402-22

UNIT-I

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;

UNIT-II

Riemann integrability of monotone and continuous functions, 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; Convergence of Beta and Gamma functions.

UNIT-III

Pointwise and uniform convergence of sequence of functions; Cauchy's general principle of uniform convergence, A test for uniform convergence of sequence of functions, Countinuity of the uniform limit of a uniformly convergent sequence of continuous functions, Integrability of uniform limit of a uniformly convergent sequence of integrable functions. Derivability of the point-wise limit of a sequence of derivable functions if the derivatives are continuous and the sequence of derivatives is uniformly convergent

UNIT-IV

Infinite Series of functions, Test for uniform convergence of a series; Cauchy's general principle of convergence and Weierstrass M-Test for uniform convergence. Abel's test and Dirichlet's test. Weierstrass Approximation Theorem.

RECOMMENDED BOOKS

1. Shanti Narayan, Dr. M.D. Raisinghania, Elements of Real Analysis, S. Chand & Company, New Delhi.
2. K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
3. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
4. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.

BSHM-403-22	**Ring Theory and Linear Algebra I**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Set Theory, Group Theory

Course Objectives: The main aim of the course is to introduce the students to basic concepts from abstract algebra, especially the notion of a ring and vector space. The course will help prepare you for further study in abstract algebra as well as familiarize you with tools essential in many other areas of mathematics. The other aim of this course is to provide the learner with the skills, knowledge and competencies to carry out their duties and responsibilities in a pure Mathematical environment.

Course Outcomes: At the end of the course, the students will be able to

CO1	learn the basic concepts like groups, subgroups, cyclic groups, normal subgroups, homomorphisms, etc.
CO2	learn about binary operations on algebraic structures which are quite significant in modern mathematics.
CO3	understand the theorems of group isomorphisms and isomorphisms.
CO4	be acquainted with prerequisite knowledge required to learn advanced algebra.
CO5	apply the learnt techniques in modern algebra.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Ring Theory and Linear Algebra I
Course Code: BSHM-403-22

UNIT-I

Ring Theory: Definition and examples of rings, properties of rings, integral domains and fields, characteristic of a ring,

Subrings and Ideals: subrings, ideals, ideal generated by a subset of a ring, operations on ideals, principal, prime and maximal ideals.

UNIT-II

Ring Homomorphism: Quotient rings, Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III.

UNIT-III

Vector Spaces: Vector spaces, vector subspaces, algebra of subspaces, disjoint subspaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, cosets of subspaces, quotient spaces, dimension of quotient spaces.

UNIT-IV

Linear transformations: Linear transformation, matrix representation of a linear transformation, properties of linear transformations, null space, range, rank and nullity of a linear transformation, algebra of linear transformations. Isomorphisms invertibility and isomorphisms, matrix of a linear transformation with respect to basis.

Text Book:

1. V. Khanna and S.K. Bhambari, Abstract Algebra, 5th Ed., Vikas Publishing House, New Delhi, 2016.

Books Recommended:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
4. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.

6. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
7. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India,1999.
8. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
9. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998

Course Title: Programming Lab-III
Course Code: BSHM-404-22

List of Practicals (using any software)

1. Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in ascending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regulai Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. SOR Method or Gauss-Siedel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpson's rule.

RECOMMENDED BOOKS:

1. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

BSHM-405-22	**Graph Theory**	**L-2, T-0, P-0**	**2 Credits**

Pre-requisite: Sets, Binary operations

Course Objectives: The main aim of the course is to introduce the students to the basic concepts of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs. They will be able to identify edges and vertices, find the degree of a vertex, express travelling salesman's problem.

Course Outcomes: At the end of the course, the students will be able to

CO1	learn the basic concepts like graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, etc.
CO2	learn about Eulerian circuits, Hamiltonian cycles.
CO3	understand the concept of the adjacency matrix, weighted graph, travelling salesman's problem.
CO4	be acquainted with the properties of shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.
CO5	apply the learnt techniques in computer algebra.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Graph Theory
Course Code: BSHM-405-22

UNIT-I

Graphs: Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs.

UNIT-II

Paths and Circuits: Introduction with examples, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Books Recommended:

1. B.A. Davey and H.A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

BHIC-211-22	**Chemistry-II**	**L-3, T-1, P-0**	**Credits: 4**

Pre-requisite: Understanding of senior secondary level chemistry

Course Objectives: This course will equip students with the necessary knowledge concerning the fundamentals in the basic areas of physical chemistry viz. different states of matter, solutions, and ionic equilibrium. The problem-solving skills of students are expected to be enhanced through due weightage given to numerical problems in each unit.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basic principles and theories pertaining to different states of matter
CO2	Solve various problems related to pH
CO3	Define the various laws pertaining to gaseous state and solutions.
CO4	Familiarize with the different colligative properties of solutions and the concept of abnormal molecular mass
CO5	Understand the basic structure and symmetry elements in solids

Mapping of course outcomes with the program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Chemistry-II
Course Code: BHIC-211-22

UNIT-I

States of Matter: The kinetic molecular theory of gases, Postulates and derivation of kinetic gas equation and various gas laws, The ideal gas law: Applications, Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z and its variation with pressure for different gases. Causes of deviation from ideal behavior. Van der Waals equation of state, its derivation and application in explaining real gas behaviour. Critical state, relation between critical constants and vander Waal constants, Numericals based on above concepts.

UNIT-II

Liquid and Solid State: Physical properties of liquids; vapour pressure, surface tension and its effects, coefficient of viscosity and effect of temperature and pressure. Liquid Crystals: their types and applications. Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law. Defects in Crystals.

UNIT-III

Ionic equilibria: Concept of Acids and Bases, degree of ionization, factors affectingdegree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids. Buffer solutions; buffer capacity, buffer range, buffer action. Salt Hydrolysis, Acid Base Titrations, Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

UNIT-IV

Solutions and Colligative Properties: Ways of expressing the concentration, Colligative properties: derivation of expression and determination of molecular masses (i) relative lowering of vapour pressure, Raoult's Law. (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure, effects of Osmosis and Semi permeability, Reverse Osmosis. Applications in calculating molar masses of normal, dissociated, and associated solutes in solution, Van't Hoff Factor, Numerical problems based on above concepts.

RECOMMENDED BOOKS:

1. P.W. Atkins & J. de Paula, Atkin's Physical Chemistry, Oxford University Press (2006).
2. S.H. Maron & C.F. Prutton, Principles of Physical Chemistry, 1st edition, Oxford and IBH (1958).
3. G.W. Castellan, Physical Chemistry, 4th edition, Narosa (2004)
4. I.N. Levine, Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010)
5. T. Engel & P. Reid, Physical Chemistry 3rd Ed., Prentice-Hall (2012)

BHIC-212-22	**Chemistry Lab-II**	L-0, T-0, P-4	Credits: 02

Pre-requisite: Understanding of senior secondary level Chemistry

Course Objectives: To provide students practical knowledge and skills about various topics taught in theory class of physical chemistry, which in turn will enhance their problem solving and analytical skills.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic procedures for carrying out a physical chemistry practical like preparation and standardization of solutions, handling the equipment and measuring with precision.
CO2	Correlate the theoretical and practical aspects and know about the limits of the experimental error.
CO3	Determine the various physical parameters for the various problems under consideration.
CO4	Verify various laws studied in the theory part.

Mapping of course outcomes with the program outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓

Course Title: Chemistry Lab-II
Course Code: BHIC-212-22

UNIT-I

Preparation and Standardization of Solutions.

UNIT-II

Surface tension measurements.
a) Determine the surface tension by (i) drop number (ii) drop weight method.
b) Study the variation of surface tension of detergent solutions with concentration.

UNIT-III

Viscosity measurement using Ostwald's viscometer.
a) Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
b) Study the variation of viscosity of sucrose solution with the concentration of solute.

UNIT-IV

pH metry
a) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
b) Preparation of buffer solutions of different pH;
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide
c) pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
d) Determination of dissociation constant of a weak acid.

Recommended Books:

1. J.B. Yadav, Practical Physical Chemistry, Krishna
2. Findlay, Practical Physical Chemistry, Longman, New York

Course Title: Business Research Methods
Course Code: BBA-401-18

Course Objective: The course aims at equipping students with an understanding of the research process, tools and techniques in order to facilitate managerial decision making.

Course Outcomes (COs): After completion of the course, the students shall be able to:

CO1: Explain the objectives and process of conducting research and its application in business.

CO2: Analyse the different types of research design and experimental errors.

CO3: Understand various techniques of sampling and methods of data collection.

CO4: Examine different types of scales and appraise about data preparation and analysis.

CO5: Identify and prepare various types of reports.

UNIT I

Research Methodology: definition, objectives, scope in management research, process of Research and limitations. Research Design: Formulating the Research Problem, Choice of Research Design, Types of Research Design, Sources of Experimental Errors

UNIT II

Sampling: Advantages and Limitation of Sampling, Sampling process, Types of Sampling: Non-probability sampling techniques, Probability sampling techniques, Sampling and non-sampling errors. Data collection: primary, secondary data collection, observation methods and survey methods.

UNIT III

Measurement Concept, Levels of measurement—Nominal, Ordinal, Interval and Ratio Attitude Measurement: Comparative scaling techniques, Non-comparative scaling techniques, Questionnaire Designing: Types, Guidelines for developing a good questionnaire

UNIT IV

Data Preparation And Analysis: Editing, Coding, Cross Tabulation and Practices through Excel (Basic Concepts) Report Writing: Types of Research Reports, Guidelines for Writing a Report, Report Format, Guidelines for evaluating a report.

Suggested Readings:

1. K.V. Rao: Research Methodology, Sterling Publishers
2. Srivastava and Rego: Business Research Methodology Tata McGraw Hill
3. Rajinder Nargundhkar : Marketing Research, Tata McGraw Hill
4. Cooper and Schindler, Business Research Methods, Tata McGraw Hill
5. C.R. Kothari : Research Methodology, New Age International Publishers

SEMESTER-V

BSHM-501-22	**Partial Differential Equations**	**L-4, T-0, P-0**	**4 Credits**

Pre-requisite: Calculus and ODE

Course Objectives: The objective of this course is to introduce partial differential equations (PDEs) and their methods of solutions. The major focus of the course will be on discussion of various solution methods and their implementations for solving a given PDE with associated conditions.

Course Outcomes: At the end of the course, the students will be able to

CO1	Evaluate PDE of both first and second order.
CO2	Analyze partial differential equations and transform into canonical form.
CO3	Apply partial derivative equation techniques to predict the behavior of certain phenomena.
CO4	Create information from partial derivative models and relate it with real problems.
CO5	Apply specific techniques to conduct research and produce innovative results.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Partial Differential Equations
Course Code: BSHM-501-22

L	T	P
4	0	0

UNIT-I

Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations.

UNIT-II

Non-linear partial differential equation of the first order, Cauchy's method of characteristics for solving Non-linear PDE, compatible systems of first order equations, Charpit's method, Jacobi's method.

UNIT-III

Method of Separation of Variables for solving first order partial differential equations. Derivation of Heat equation, Wave equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

UNIT-IV

The Cauchy problem, the Cauchy-Kowalewskaya 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.

RECOMMENDED BOOKS:

1. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
3. Martha L Abell, James P Braselton, Differential equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.

BSHM-502-22	**Group Theory- II**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Group Theory-I

Course Objectives: The main objective of the course is to introduce the students to learn basic concepts from abstract algebra, especially the notion of group automorphisms, Group actions. The course will help prepare the students to apply the concepts like Cayley's theorem, Sylow's theorems, etc. in abstract algebra as well as utilize them in many other areas of mathematics.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic concepts like group automorphism, cyclic groups, commutator subgroup, etc.
CO2	Apply group actions on algebraic structures which are quite significant in modern mathematics.
CO3	Understand the theorems, namely, Cayley's theorem, Sylow's theorems, Cauchy theorem, etc.
CO4	Apply introductory knowledge to learn advanced algebra.
CO5	Apply the learnt techniques in modern algebra.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Group Theory-II
Course Code: BSHM-502-22

L	T	P
5	1	0

Unit-I

Automorphism: Inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

Unit-II

Conjugate Classes: Conjugate element of a group, Theorems relating to relations of conjugacy, conjugate class of an element, Theorems relating to order of conjugacy classes, class equation of a groups.

Unit-III

Direct Product: Properties of external direct products, external direct product of cyclic groups, Internal direct products**.**

Finite Abelian Groups: Cauchy's theorem for finite abelian groups, Converse of Lagrange theorem for abelian groups.

Unit-IV

Sylow's Theorems: p −groups, Sylow's theorems and consequences, Finite abelian group as direct product of Sylow's p −subgroups, Fundamental Theorem of finite abelian groups.

Reference Books:

1. V.K. Khanna and S.K. Bhambri, A course in Abstract Algebra, 5th Ed., Vikas Publishing House Pvt. Ltd, Noida.

Recommended Books:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
4. David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
5. J.R. Durbin, Modern Algebra, John Wiley & Sons, New York Inc., 2000.
6. D. A. R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

BSHM-503-22	**Introduction to Number Theory**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Elementary Algebra

Course Objectives: The main objective of the course is to introduce History of Numbers, their development, their properties, divisibility theorem, GCD, LCM and other basic concepts from Diophantine equations, etc. The course will help to prepare the students to apply the concepts like Chinese remainder theorem, divisibility tests in real life problems as well as utilize them in many other areas of mathematics.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic concepts like Archimedean property, Euclid Algorithm, Sieve of Eratosthenes, etc.
CO2	Apply solvability of congruence equations, Diophantine equations, etc which is quite significant in modern mathematics.
CO3	Analyze the theorems, namely, Chinese Remainder Theorem, Fermat's theorem, Wilson's theorem, Euler theorem, etc.
CO4	Apply introductory knowledge to learn advanced number theory.
CO5	Create new techniques in mathematics.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Introduction to Number Theory
Course Code: BSHM-503-22

L	T	P
5	1	0

Unit-I

Properties of Numbers: Well ordering Principle, Archimedean Property, Principle of finite induction, Binomial theorem, Triangular number, Sum, difference, and product of triangular numbers.

Unit-II

Divisibility Theory: division Algorithm, Greatest common divisor (GCD) and its properties, Euclid's Algorithm, Least common multiplier and its properties, Relation between GCD and LCM, Linear Diophantine equations, Solvability theorems, solutions of Linear Diophantine Equations.

Unit-III

Primes and their Distribution: Fundamental theorem of arithmetic, irrational numbers, Sieve of Eratosthenes to check the primality, Golbach conjecture, Euclid's Infinite prime number theorem, Product of consecutive 'r' integers.

Unit-IV

Theory of Congruences: Basic properties of congruences, Special divisibility tests, Linear congruences and their incongruent solutions, Chinese remainder theorem, Fermat's Little theorem, Wilson's theorem, Euler's theorem.

Reference Books:

7. David M. Burton, Elementary Number Theory, 7th Ed., Tata McGraw-Hill, 2007, Print.

Recommended Books:

1. Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd. 2007.

BSHM-504-22	**Mathematical Statistics**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Calculus and basic algebra

Course Objectives: This course is designed to introduce the fundaments of mathematical statistics to the students. The major focus of the course will be on theoretical foundation of these fundamentals and their applications.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand and demonstrate the notion of randomness.
CO2	Analyze a given data using measures of central tendency, dispersion, skewness and kurtosis.
CO3	Apply the concepts of probability in modeling processes and decision making
CO4	Apply the theory of probability distributions in real world situations.
CO5	Apply the principle of least squares to fit a curve from a given data
CO6	Analyze given data using the concepts of correlation and regression.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓			✓
CO2	✓	✓			✓
CO3	✓	✓			✓
CO4	✓	✓			✓
CO5	✓	✓			✓
CO6	✓	✓			✓

Course Title: Mathematical Statistics
Course Code: BSHM-504-22

L	T	P
5	1	0

UNIT-I

Frequency distributions and measures of central tendency: Mean, median, mode, partition values, Measures of dispersion, skewness and kurtosis.

Random experiment, sample space, event, algebra of events, probability axioms, probability definition, addition law of probability, multiplication law of probability, conditional probability and independence, Bayes' Theorem.

UNIT-II

Random variables, distribution function, properties of distribution function, discrete random variable, probability mass function, discrete distribution function, continuous random variable, probability density function. Continuous distribution function.

UNIT-III

Mathematical expectation, expectation of a random variable, Discrete probability distributions: binomial, Poisson, negative binomial distribution, uniform. Continuous probability distributions: uniform distribution, normal distribution, normal distribution as a limiting case of binomial distribution, exponential distribution.

UNIT-IV

Curve fitting and principle of least squares: Fitting of a straight-line, second-degree parabola and polynomial of $k-$th degree, fitting of exponential curve.

Correlation: Bivariate distribution, correlation, scatter diagram, Karl Pearson coefficient of correlation, limits for correlation coefficient, Rank correlation, limits for rank correlation coefficients.

Regression: lines of regression, regression curves, regression coefficients, properties of regression coefficients, angle between two lines of regression.

TEXT BOOKS

1. S.C. Gupta, V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.

RECOMMENDED BOOKS:

6. S. Ross, A First Course in Probability, Pearson, 2008.

7. Robert V. Hogg, Joseph W. Mckean and Allen T. Craig, Introduction to Mathematical Statistics, 7th Ed., Pearson Education, Asia 2006.
8. V. K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, John Wiley & Sons, 2015.

BSHM-505-22	**Programming Lab-IV**	**L-0, T-0, P-4**	**2 Credits**
Pre-requisite: Basic knowledge of any mathematical software (e.g. MATLAB, MATHEMATICA, MAPLE etc.)			
Course Objectives: This Lab is designed to deal with a given partial differential equation using a mathematical software. The major focus of the Lab is to get solutions of a given PDE and to plot them.			
Course Outcomes: At the end of the course, the students will be able to			
CO1	Apply a mathematical software to solve a given linear PDE analytically.		
CO2	Analyze solutions of a given PDE by plotting them.		
CO3	Understand and obtain characteristics of a first order PDE		
CO4	Apply a mathematical software for solving wave equation with different conditions.		
CO5	Apply a mathematical software for solving other types of PDEs		

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Course Title: Programming Lab-IV

Course Code: BSHM-505-22

L	T	P
0	0	4

List of Practical (Using any software)

(i) Solution of Cauchy problem for first order PDE.
(ii) Finding the characteristics for the first order PDE.
(iii) Plot integral surfaces of a given first order PDE with initial data.
(iv) Solution of wave equation with associated conditions.
(v) Solving some other types of PDEs, for example quasilinear PDEs.

RECOMMENDED BOOKS:

3. Higham, D.J. and Higham, N.J., MATLAB Guide, 2nd Edition. Society for Industrial and Applied Mathematics (SIAM), 2005.
4. Gilat, A., MATLAB: An Introduction with Applications, 5th Edition. John Wiley & Sons, 2014.
5. Stephen Wolfram, THE MATHEMATICA BOOK, 5th Edition, 2003, Wolfram Media.
6. M. L. Abell, J. P. Braselton, MATHEMATICA by Example, 4th Edition, Elsevier, 2009.

BSHM-EVS-101 A	**Environmental Science**	**L-2, T-0, P-0**	**2 Credits**

Pre-requisite: Basic knowledge of environment.

Course Objectives: This course will equip students with the necessary knowledge and make them aware about the environmental issues.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand environmental problems at local and national level through literature and general awareness.
CO2	Gain practical knowledge by visiting wildlife areas, environmental institutesand various personalities who have done practical work on various environmental Issues.
CO3	Apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems
CO4	Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world**.**
CO5	Become aware of the local, regional and global environmental problems**.**

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1					✓
CO2					✓
CO3					✓
CO4					✓
CO5					✓

Course Title: Environmental Science

Course Code: EVS-101 A

L	T	P
2	0	0

Unit-I

Introduction to Environmental Studies

Multidisciplinary nature of Environmental Studies**:** Scope &Importance, Need for Public Awareness

Ecosystems

Concept of an Ecosystem: Structure & functions of an ecosystem (Producers, Consumers & Decomposers) Energy Flow in anecosystem: Food Chain, Food web and Ecological Pyramids, Characteristic features, structure & functions of following Ecosystems: Forest Ecosystem, Aquatic Ecosystem (Ponds, Lakes, River & Ocean)

Unit-II

Natural Resources

Renewable & Non-renewable resources, Forest Resources*:* Their uses, functions & values *(*Biodiversity conservation, role in climate change, medicines*)* & threats *(*Overexploitation, Deforestation, Timber extraction, Agriculture Pressure*)*, Forest Conservation Act

Water Resources*:* Their uses *(*Agriculture, Domestic & Industrial*)*, functions & values, Overexploitation and Pollution of Ground & Surface water resources *(*Case study of Punjab*)*, Water Conservation, Rainwater Harvesting

Land Resources*:* Land as a resource; Land degradation, soil erosion and desertification

Energy Resources*:* Renewable & non-renewable energy resources, useof alternate energy resources *(*Solar, Wind, Biomass, Thermal*)*, Urban problems related to Energy

Unit-III

Biodiversity & its conservation

Types of Biodiversity**:** Species, Genetic & Ecosystem

India as a mega biodiversity nation, Biodiversity hot spots andbiogeographic regions of India, Biodiversity Conservation and its types,

Examples of Endangered & Endemic species of India, Red data book

Unit-IV

Environmental Pollution & Social Issues

Types, Causes, Effects & Control of Air, Water, Soil & Noise Pollution, Nuclear hazards and accidents & Health risks, Global Climate Change**:** Global warming, Ozone depletion, Acid rain, Meltingof Glaciers & Ice caps, Rising sea levels**.**

Environmental disasters**:** Earthquakes, Floods, Cyclones, Landslides

Field Work

Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary Documentation & preparation of a Biodiversity (flora & fauna) registerof campus/river/forest

Visit to a local polluted site: Urban/Rural/Industrial/Agricultural Identification & Photography of resident or migratory birds, insects(butterflies)
Public hearing on environmental issues in a village

RECOMMENDED BOOKS

1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission,New Delhi.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad– 380 013, India.
3. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
4. Down to Earth, Centre for Science and Environment (R)
5. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment& Security. Stockholm Env. Institute Oxford Univ. Press. 473p
6. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. CambridgeUniv. Press 1140p.
7. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
8. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
9. Survey of the Environment, The Hindu (M)

BSHM-506-22	**Computer Algebra System & Related Software**	**L-0, T-0, P-2**	**Non-Credit**

Pre-requisite: A basic knowledge of Computer.

Course Objectives: The objective of this course is to introduce computer algebra system: Mathematica and other software: Matlab and R open-source package. The major focus of the course will be on use of these software for solving mathematical and statistical problems.

Course Outcomes: At the end of the course, the students will be able to

CO1	Apply Mathematica for solving mathematical problems, for example, nonlinear equations, calculus problems and differential equations etc.
CO2	Apply Matlab for solving scientific problems.
CO3	Apply R open-source package for solving statistical problems.
CO4	Create their own Mathematica programs.
CO5	Apply Matlab for plotting of functions.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1		✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3		✓	✓	✓	✓
CO4		✓	✓	✓	✓
CO5		✓	✓	✓	✓

Course Title: Computer Algebra System and Related Software

Course Code: BSHM-506-22

L	T	P
0	0	2

UNIT-I

The structure of MATHEMATICA, notebook interfaces, constants, variables, algebraic calculations, four kinds of brackets, lists, tables, expressions, functions, built-in functions, functional operations, graphics, patterns, manipulating lists, transformation rules, evaluation of expressions, modularity, manipulating notebooks, relational and logical operators. Symbolic math commands: D; Integrate; Sum; Product; Solve: Eliminate; Reduce: Series: Limit; Minimize; Programming: conditionals; loops: Do; For and While.

UNIT-II

Use of MATLAB as calculator, in computing function values, in making graphs, for exploring linear algebra and to plot curve and surfaces.

Introduction to R- open-source package, R as a calculator, built-in functions, operators, creating a vector, vector functions, writing functions in R. Applications of R in measures of central tendency.

RECOMMENDED BOOKS

1. Wolfram, S., The MATHEMATICA Book, 5^{th} revised edition. Wolfram Media Inc, 2004.
2. Abell, M. and Braselton, J., Mathematica by Example, 5^{th} Edition. Academic Press, 2017.
3. Lent, C.S., Learning to Programming with MATLAB: Building GUI Tools, Wiley, 2013.
4. Amos Gilat. MATLAB, An Introduction with Applications, 2004.
5. Michael J. Crawley, Statistics: An Introduction using R, 2nd Edition, Wiley, 2015.
6. W. John Braun, Duncan J. Murdoch, A First Course in Statistical Programming with R, 3rd Edition, Cambridge University Press, 2021.

SEMESTER-VI

BSHM-601-22	**Complex Analysis**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Complex numbers system and Calculus of several variables.

Course Objectives: The objective of this course is to introduce function of a complex variable and concepts of calculus of complex variable function. The major of the course will be on a systematic mathematical treatment of these concepts and their applications.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand Complex functions, their continuity, differentiability and integration.
CO2	Understand the concept of analytic functions, decide when and where a given function is analytic and be able to find its series development.
CO3	Describe basic properties of complex integration and having the ability to compute such integrals.
CO4	Analyze the concept of singularity and poles.
CO5	Apply residue theorem to compute the several kinds of real integrals.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Complex Analysis

Course Code: BSHM-601-22

L	T	P
5	1	0

UNIT-I

Function of complex variables, limit, continuity and differentiability. Analytic functions, Harmonic functions, Cauchy-Riemann equations (Cartesian and Polar form), sufficient condition for differentiability, Construction of analytic functions.

UNIT-II

Curves, simply closed curves, Complex line integral, Path independence of a line integral, Cauchy's theorem, Cauchy's integral formula and applications. Liouville's theorem and its consequences.

UNIT-III

Taylor's theorem, Laurent's theorem and their examples. Zeros and singularities of an analytic function, Residue at a pole and at infinity, Cauchy's Residue theorem.

UNIT-IV

Evaluation of definite integrals, integration round the unit circle, Evaluation of the integral of the form $\int_{-\infty}^{\infty} f(x)dx$, Jordan's inequality, Jordan's lemma, Integral of the form $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \sin mx dx$ etc.

Recommended Books:

1. E. T. Copson, Theory of functions of complex variables. Oxford university press.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
3. J.B. Conway, Functions of one complex variable (Second Edition), Springer.
4. J. W. Brown and R. V. Churchill, Complex variables and applications, 8th Edition, McGraw Hill, Higher Education.
5. H.S. Kasana, Complex Variable, Theory and Applications, PHI.
6. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House.

BSHM-602-22	**Ring Theory and Linear Algebra-II**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Ring Theory and Linear Algebra-I

Course Objectives: The main objective of the course is to introduce the basic concepts from abstract algebra, especially the notion of group automorphisms, Group actions. The course will help the students to apply the concepts like field extensions, splitting fields etc. in abstract algebra as well as utilize in many other areas of mathematics.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the basic concepts like polynomial rings, Division theorem, Factorization of polynomials, irreducibility, etc.
CO2	Apply Eisenstein criterion of irreducibility, Eigen Spaces, Diagonalization, Dual Spaces, Annihilators, etc. which are quite significant in modern mathematics.
CO3	Understand the theorems, namely, Gauss theorem, Cayley Hamilton theorem, etc.
CO4	Utilize introductory knowledge to learn advanced algebra.
CO5	Create and apply the new techniques in modern algebra.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Ring Theory and Linear Algebra-II
Course Code: BSHM-602-22

L	T	P
5	1	0

Unit-I

Field of quotients of Integral Domain, Polynomial rings over commutative rings, Division algorithm and consequences: Remainder Theorem, Factor Theorem, Prime element and irreducible element, Principal ideal domains, GCD and LCM of two polynomials.

Unit-II

Euclidean Domain, Unique Factorization Domain, relation between ED, PID and UFD, Primitive polynomials, Irreducible polynomials, Gauss Lemma, Gauss theorem on irreducible elements, Eisenstein criterion of irreducibility.

Unit-III

Polynomial of matrices and linear operators, Eigen Values and Eigen Vectors, Characteristic subspace of a matrix, Cayley-Hamilton theorem, Eigen Space, Annihilating polynomials, Minimal Polynomials, Diagonalization of a linear operator.

Unit-IV

Linear functional, Dual Spaces, Dual basis, Natural mapping and reflexivity, Annihilator, Transpose or adjoint of a linear transformation.

Reference Books:

2. V.K. Khanna and S.K. Bhambri, A course in Abstract Algebra, 5th Ed., Vikas Publishing House Pvt. Ltd, Noida.
3. KP Gupta, Linear Algebra, Pragati Prakashan, Meerut.

Recommended Books:

8. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
9. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
10. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
11. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
12. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
13. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
14. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
15. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
16. S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.

BSHM-603-22	**Theory of Equations**	**L-5, T-1, P-0**	**6 Credits**

Prerequisite: Basic algebra

Course Objectives: The objectives of this course are to discuss properties of polynomials and their graphical representation, introduce Descarte's rule of sign, relation between roots and coefficients of an equation. Further, to deal with the concept of symmetric function and its applications, and Strum sequence and its applications.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the different properties of polynomials.
CO2	Apply Descarte's rule of sign to find nature of the roots of an equation.
CO3	Apply the concept of symmetric function.
CO4	Evaluate cubic and biquadratic equations.
CO5	Apply Strum sequence in identifying the distinct real roots of a polynomial in an interval.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	✓	✓	-	-	✓
CO2	✓	✓	-	-	✓
CO3	✓	✓	-	-	✓
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	✓

Course Title: Theory of Equations

Course Code: BSHM-603-22

L	T	P
5	1	0

UNIT-I

General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

UNIT-II

Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

UNIT-III

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

UNIT-IV

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.

Recommended Books:

1. W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
2. C. C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954.

BSHM-604-22	Mathematical Modeling	L-4, T-0, P-0	4 Credits

Pre-requisite: Calculus and basic linear algebra

Course Objectives: This course is designed to introduce basics of Mathematical modeling in order to write physical phenomena in mathematical terms and also to discuss of linear ordinary differential equations. The major focus of the course will be on a systematic mathematical treatment of these concepts.

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand system of ODEs and interpret their solutions.
CO2	Understand and deal with different mathematical models such as simulation and linear programming model.
CO3	Apply the concepts of mathematical modeling to formulate real world phenomena into mathematical terms.
CO4	Apply Monte Carlo simulation to find area under a curve and volume of a surface.
CO5	Apply Simplex method for solving linear programming problems.

Mapping of course outcomes with the program outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	✓	✓			✓
CO2	✓	✓			✓
CO3	✓	✓			✓
CO4	✓	✓			✓
CO5	✓	✓			✓

Course Title: Mathematical Modeling
Course Code: BSHM-604-22

L	T	P
4	0	0

UNIT-I

Systems of linear ordinary differential equations: differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

UNIT-II

Introduction to mathematical modeling, modeling approaches, classifications and some characteristics of mathematical modeling, limitations of mathematical modeling. Interacting population models: Influenza outbreak, predators and prey, competing species, model of a battle (with case studies).

UNIT-III

Simulation: introduction and limitations, Monte Carlo Simulation modeling: (deterministic) Area under a curve, volume under a surface, generating random numbers, middle square method, linear congruence.

UNIT-IV

Linear programming model: assumptions in linear programming models, formulation of simple linear programming models, limitations of linear programming models, graphical method of solution, Simplex method for solving problems containing two variables.

RECOMMENDED BOOKS

1. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
2. B. Barnes and G. R. Fulford, Mathematical Modelling with Case Studies: Using Maple and Matlab,3rd Edition, 2015, CRC Press, Taylor & Francis Group.
3. Frank. R. Giordano, William. P. Fox, Steven B. Horton, A First Course in Mathematical Modeling, 5th Edition, 2014 Cengage Learning.
4. Dennis G. Zill, Advanced Engineering Mathematics, 6th Edition, 2018, Jones & Bartlett Learning.
5. P. K. Gupta, D. S. Hira, Operations Research, 7th Edition, S. Chand & Company, Pvt. Ltd, 2014.

BSHM-605-22	**Programming Lab-V**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Basic knowledge of any mathematical software (e.g. MATLAB, MATHEMATICA, MAPLE etc.)

Course Objectives: This Lab is designed to deal solution of differential equations, Monte Carlo simulation and Simplex method using application of any software. The major focus of the Lab will be on effective implementation of mathematical software to use built-in tools/ features for solving the above said problems.

Course Outcomes: At the end of the course, the students will be able to

CO1	Apply mathematical software to solve a system of ODEs
CO2	Analyze graphical behavior of solutions of different mathematical models.
CO3	Create random numbers and understand their applications.
CO4	Apply software for simulating area under a curve and volume under a surface.
CO5	Analyze optimal solution of a linear programming problem.

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1		✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3		✓	✓	✓	✓
CO4		✓	✓	✓	✓
CO5		✓	✓	✓	✓

Course Title: Programming Lab-V

Course Code: BSHM-605-22

L	**T**	**P**
0	**0**	**4**

List of Practical (Using any software)

(i) Introduction to built-in features of a mathematical software.
(ii) Solving a system of linear ordinary differential equations.
(iii) Phase plane analysis of predator-prey model.
(iv) Phase plane analysis of model of a battle.
(v) Random number generation and then use it for one of the following
(a) Simulate area under a curve (b) Simulate volume under a surface.
(vi) Solving linear programming problems with two variables.

RECOMMENDED BOOKS:

1. Higham, D.J. and Higham, N.J., MATLAB Guide, 2nd Edition. Society for Industrial and Applied Mathematics (SIAM), 2005.
2. Gilat, A., MATLAB: An Introduction with Applications, 5th Edition. John Wiley & Sons, 2014.
3. Stephen Wolfram, THE MATHEMATICA BOOK, 5th Edition, 2003, Wolfram Media.
4. M. L. Abell, J. P. Braselton, MATHEMATICA by Example, 4th Edition, Elsevier, 2009.

BSHM-606-22	**Scientific Documentation Tool**	**L-0, T-0, P-2**	**Non-Credit**
Pre-requisite: A basic knowledge of Computer.			
Course Objectives: This course is designed to introduce a Scientific Documentation Tool namely Latex for effectively writing mathematical articles, project reports and general mathematics content. The major focus of the course will be on effective use of Latex features to make an appealing presentation of a scientific document.			
Course Outcomes: At the end of the course, the students will be able to			
CO1	Create tables using Latex features.		
CO2	Apply Latex for creating effective scientific documents.		
CO3	Understand different types documents that can be created using Latex.		
CO4	Understand and use different packages to various features of Latex.		
CO5	Apply Latex to create theorem and equation environments in a scientific document.		

Mapping of course outcomes with the program outcomes

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1		✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3		✓	✓	✓	✓
CO4		✓	✓	✓	✓
CO5		✓	✓	✓	✓

Course Title: Scientific Documentation Tool

Course Code: BSHM-606-22

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0	0	2

Latex: Sample documents, Type style, Resources

Environments: Lists, Centering, Tables, Verbatim, Theorem like environments, Equation environment

Type Setting: Fonts, Hats, Underlining, Braces, Arrays, Matrices, Math styles, Bold Math, Symbols for number sets, Binomial Coefficients

Documents: Document Class, Title, Section commands

Packages: Inserting files, inserting pictures, Making a bibliography

RECOMMENDED BOOKS

1. Lamport, L., LATEX: A Document Preparation System, User's Guide a Reference Manual, 2™ Edition, Addison-Wesley, 1994.
2. Erickson M.J. and Binder, D., A student's Guide to the Study, Practice and Tools of Modern Mathematics, CRC Press, 2011.