Bachelor of Science (Honours)

Mathematics

AY: 2020- 21

Program and Course Structure

School of Basic Science and Research
Department of Mathematics

B.Sc.(H) Mathematics

SBR0302

Batch 2020-23

1.1 Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. Transformative educational experience
2. Enrichment by educational initiatives that encourage global outlook
3. Develop research, support disruptive innovations and accelerate entrepreneurship.
4. Seeking beyond boundaries.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

1.2 Vision and Mission of the School

Vision of the School

Achieving excellence in the realm of science to address the challenges of evolving society.

Mission of the School

1. Equip the students with knowledge and skills
2. Capacity building by providing academic flexibility to student and Faculty members
3. To establish centre of excellence for innovative research
4. Address the deficiencies of the society pertaining to environment
5. To strengthen academic- industry collaboration for better Employability.
6. Developing a culture for continued betterment in all facets of life

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

1.3 Vision and Mission Department of Mathematics

Vision of the Department

To become a globally recognized destination for education in applied mathematics and research.

Mission of the Department

1. To develop mathematical skills in students and make them employable across a wide range of professions and promote interest research.

2. To develop entrepreneurial skills in students to serve the society at large.

3. To develop skills for the applications of mathematics in the various fields.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

1.4 Programme Educational Objectives (PEO's)

PEO1: To prepare students for developing their subject knowledge in the courses of their study to enable them to shine in various fields such as sciences, engineering and technology, IT etc.
PEO2: To develop positive attitude and skills this will enable the students to become a multi facet personality.
PEO3: To prepare students for entrance examinations conducted by IIT's/Universities to pursue PG and Ph. D. programs.
PEO4: To develop students into confident communicators and team players.

1.4.1Program Outcomes (PO's)

PO1: Mathematical knowledge: Application of Mathematical knowledge in various fields of science, engineering and management etc.
PO2: Nature of Mathematics: Understand the concise, precise and rigorous nature of Mathematics.
PO3: `Critical thinking: Develop the skill to think critically on abstract concepts of Mathematics.
PO4: Problem analysis: Develop the ability to analyze a problem logically and dissect into micro-parts and thus resolving the problem to accessible components.
PO5: Presentation skill: Develop the skill to pleasant exposition for successful presentation for any career interview with confidence.
PO6: Mathematical logic: Formulates and develops mathematical arguments in logical manner.
PO7: Team Work: Work as a team player and strive for self-excellence.
PO8: **Ethics:** Realize and understand professional, ethical and cultural responsibilities.
PO9: Communication: Communicate effectively with an elite audience.
PO10:Life-long learning: Engage in life-long learning towards enduring professional development.

1.4.2 Mapping of PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4	School Mission 5	School Mission 6
PEO1:	3	2	3	1	2	3
PEO2:	3	2	3	1	2	3
PEO3:	3	3	3	3	3	3
PEO4:	3	2	3	1	3	3

1.4.3 Mapping of Program Outcome Vs Program Educational Objectives

	PEO1	PEO2	PEO3	PEO4
PO1	3	3	3	2
PO2	3	3	3	2
PO3	3	3	3	2
PO4	3	2	3	2
PO5	2	3	2	3
PO6	3	3	3	2
PO7	1	2	1	3
PO8	2	2	1	3
PO9	2	2	2	3
PO10	2	2	2	3

1. Slight (Low) ***2. Moderate (Medium)*** ***3. Substantial (High)***

1.4.5 Program Outcome Vs Courses Mapping Table:

1.4.5.1 COURSE ARTICULATION MATRIX

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PHB 114	1	2	1	2	2	1	2	1	1	2
BCH 101	1	2	2	1	2	1	2	1	1	1
CSE 115	2	1	1	2	1	2	2	1	2	2
ARP 101	1	1	2	1	1	1	1	2	1	2
PHB 151	2	1	1	1	2	2	1	2	2	1
BCH 151	1	1	1	1	2	1	1	2	2	1
MSM 101	3	3	2	3	2	2	1	2	2	1
PHB 115	1	2	1	2	2	1	2	1	1	2
PHB 117	2	2	1	2	2	1	2	1	1	2
BCH 102	1	2	1	2	2	1	2	1	1	2
MSM 105	3	3	2	3	3	2	2	1	2	2
MTH 215	2	3	3	3	2	2	2	1	2	2
EVS 106	1	2	1	2	2	1	2	1	1	2

PHB 152	1	1	1	1	2	1	1	2	2	1
BCH 152	2	1	1	2	2	1	1	2	2	1
MSM 204	3	3	2	2	3	2	2	2	2	2
MSM 207	3	3	2	3	2	2	2	2	1	2
MSM 219	2	3	2	3	2	2	3	2	2	2
BCH 201	2	1	2	1	2	1	1	2	2	1
PHB 219	2	1	1	1	2	1	1	2	2	1
CCU 401	-	-	1	1	2	-	2	1	-	2
MSM 251	3	3	2	3	2	3	2	3	2	2
MSM 250	3	3	2	3	2	3	2	3	2	2
MSM 214	2	3	2	3	2	3	2	2	2	2
MSM 216	2	3	2	3	2	2	3	2	2	2
MSM 208	3	3	3	3	2	2	2	2	3	2
MSM 213	2	3	2	3	3	2	2	2	2	1
MSM 211	3	3	2	3	2	2	2	2	1	2
MSM 212	2	3	2	3	2	2	3	2	2	2
MSM 254	3	3	2	3	3	2	3	2	2	3
MSM 253	3	3	2	3	3	2	2	2	2	2
MSM 315	3	3	3	3	2	2	2	2	2	3
MSM 311	3	3	2	2	3	2	2	2	2	2

MSM 302	3	3	2	2	3	2	2	2	2	2
MSM 307	3	3	2	3	3	2	2	2	2	2
MSM 312	3	3	2	3	2	3	2	2	2	2
MSM 314	3	3	2	3	2	2	2	2	2	2
MSM 355	3	3	3	3	2	2	2	2	2	1
MSM 361	2	3	2	2	3	2	2	2	2	2
MSM 301	3	3	3	2	2	2	2	3	2	2
MSM 306	3	3	2	2	3	2	2	2	2	2
MSM 308	3	3	2	3	2	2	2	3	2	2
MSM 316	2	3	2	3	2	2	3	2	2	2
MSM 313	2	2	2	3	2	2	3	2	2	2
MSM 356	3	3	2	3	2	3	2	2	2	2
MSM 354	2	3	2	3	2	3	3	3	2	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

Program Structure Template
Department of Mathematics
School of Basic Sciences & Research
B. Sc. (H) Mathematics
Batch: 2020-2023
TERM: I

S. No.	SUBJECT CODE	Title of Paper	Teaching Load				CREDITS	PRE-REQUISITE/ CO-REQUISITE	Type of Course: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY		**L**	**T**	**P**	**TOTAL (hrs.)**			
1.	PHB 114	Mechanics and Properties of Matter	3	1	0	4	4	Co Requisite	DSE
2.	BCH 101	Physical Chemistry-1	3	1	0	4	4	Co Requisite	DSE
3.	MSM 101	Foundation Course in Mathematics	3	1	0	4	4	Pre-Requisite	CC
4.	CSE115	Introduction to programming	3	1	0	4	4	Co Requisite	DSE
	PRACTICALS								
5.	PHB 151	Physics Lab-1	0	0	2	2	1	Co Requisite	AECC
6	BCH 151	Chemistry Lab-1	0	0	2	2	1	Pre Co Requisite	AECC
7.	ARP 101	Communicative English 1	1	0	2	3	2	Co Requisite	AECC
TOTAL			**13**	**4**	**4**	**21**	**20**		

Program Structure Template
Department of Mathematics
School of Basic Sciences & Research
B. Sc. (H) Mathematics
Batch: 2020-2023
TERM: II

S. No.	SUBJECT CODE	Title of Paper	Teaching Load				CREDITS	PRE-REQUISITE/ CO-REQUISITE	Type of Course[1]: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY		**L**	**T**	**P**	**TOTAL (hrs.)**			
1.	PHB 115/ PHB 117	Optics/ Thermal Physics	3	1	0	4	4	Co Requisite	DSE
2.	BCH 102	Organic Chemistry-1	3	1	0	4	4	Co Requisite	DSE
3.	MSM 105/ MTH 215	Calculus-1 / Biostatistics (for Chemistry)	3	1	0	4	4	Pre-Requisite	CC
4.	MSM 106	Linear Algebra	3	1	0	4	4	Pre-Requisite	CC
5.	EVS106	Environmental Sciences	3	0	0	3	3	Co Requisite	AECC
	PRACTICALS								
6.	PHB 152	Physics Lab-2	0	0	2	2	1	Co Requisite	AECC
7	BCH 152	Chemistry Lab-2	0	0	2	2	1	Pre Co Requisite	AECC
TOTAL			**15**	**4**	**4**	**23**	**21**		

[1] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Program Structure Template
Department of Mathematics
School of Basic Sciences & Research
B. Sc. (H) Mathematics
Batch: 2020-2023
TERM: III

S. No.	SUBJECT CODE	Title of Paper	Teaching Load				CREDITS	PRE-REQUISITE/ CO-REQUISITE	Type of Course2: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY		**L**	**T**	**P**	**TOTAL (hrs.)**			
1.	MSM 204	Calculus II	3	1	0	4	4	Co-requisite	CC
2.	MSM 207	Statistics I	3	1	0	4	4	Co-requisite	CC
3.	MSM 229	Introduction to MATLAB	3	1	0	4	4	Co-requisite	AECC
4.	BCH 201	Inorganic Chemistry I	3	1	0	4	4	Co-requisite	DSE
5.	PHB 219	Electricity and Magnetism	3	1	0	4	4	Co-requisite	DSE
6.	OPE	Open Elective opted by students (under CBCS)	2	0	0	2	2	Pre-requisite	SEC
	PRACTICALS								
7.	MSM 251	Mathematics Lab. I	0	0	2	3	2	Co-requisite	AECC
8.	MSM 250	StatisticsLab I	0	0	2	2	1	Co-requisite	AECC
9.	CCU 401	Community Connect	2	0	0	2	2	Co-requisite	SEC
TOTAL			**19**	**5**	**4**	**29**	**27**		

[2] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Program Structure Template
Department of Mathematics
School of Basic Sciences & Research
B. Sc. (H) Mathematics
Batch: 2020-2023
TERM: IV

S. No.	SUBJECT CODE	Title of Paper	Teaching Load				CREDITS	PRE-REQUISITE/ CO-REQUISITE	Type of Course3: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY		**L**	**T**	**P**	**TOTAL (hrs.)**			
1.	MSM 214	Ordinary Differential Equations	3	1	0	4	4	CO-REQUISITE	CC
2.	MSM 216	Analytical Geometry	3	1	0	4	4	CO-REQUISITE	CC
3.	MSM 208	Real Analysis I	3	1	0	4	4	CO-REQUISITE	CC
4.	MSM 213	Numerical sAnalysis	3	1	0	4	4	CO-REQUISITE	CC
5.	MSM 211	Statistics II	3	1	0	4	4	CO-REQUISITE	CC
6.	MSM 212	Mathematical Logic Building I	2	0	0	2	2	CO-REQUISITE	AECC
	PRACTICALS								
7.	MSM 254	Mathematics Lab II (Using MATLAB)	0	0	3	3	2	CO-REQUISITE	AECC
8.	MSM 253	Statistics lab II (Based on MSM 213, Using data analysis package of Excel)	0	0	3	3	2	CO-REQUISITE	AECC
TOTAL			**17**	**5**	**6**	**28**	**26**		

[3] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Program Structure Template
Department of Mathematics
School of Basic Sciences & Research
B. Sc. (H) Mathematics
Batch: 2020-2023
TERM: V

S. No.	SUBJECT CODE	Title of Paper	Teaching Load				CREDITS	PRE-REQUISITE/ CO-REQUISITE	Type of Course4: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY		**L**	**T**	**P**	**TOTAL (hrs.)**			
1.	MSM 302	Real Analysis II	3	1	0	4	4	CO-REQUISITE	CC
2.	MSM 315	Operation Research	3	1	0	4	4	CO-REQUISITE	CC
3.	MSM 307	Abstract Algebra	3	1	0	4	4	CO-REQUISITE	CC
4.	MSM 311	Partial Differential Equations	3	1	0	4	4	CO-REQUISITE	CC
5.	MSM 312	Discrete Mathematics	3	1	0	4	4	CO-REQUISITE	CC
6.	MSM 314	Mathematical Logic Building-2	2	0	0	2	2	CO-REQUISITE	AECC
	Practical/ Project								
7.	MSM 355	Mathematics Lab III (Based on MSM 312, MSM 315)	0	0	3	3	2	CO-REQUISITE	AECC
8.	MSM 361	Dissertation I	3	0	0	3	3	CO-REQUISITE	AECC
TOTAL			**20**	**5**	**3**	**28**	**27**		

[4] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Program Structure Template
Department of Mathematics
School of Basic Sciences & Research
B. Sc. (H) Mathematics
Batch: 2020-2023
TERM: VI

S. No.	SUBJECT CODE	Title of Paper	Teaching Load				CREDITS	PRE-REQUISITE/ CO-REQUISITE	Type of Course5: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY		**L**	**T**	**P**	**TOTAL (hrs.)**			
1.	MSM 301	Complex Analysis	3	1	0	4	4	CO-REQUISITE	CC
2.	MSM 306	Mechanics	3	1	0	4	4	CO-REQUISITE	CC
3.	MSM 308	Graph Theory	3	1	0	4	4	CO-REQUISITE	CC
4.	MSM 316	Metrics Spaces	3	1	0	4	4	CO-REQUISITE	CC
5.	MSM 313	Applied Statistics	3	1	0	4	4	CO-REQUISITE	CC
	Practical/ Project								
6.	MSM 356	Mathematics Lab IV (La TeX / HTML)	0	0	3	3	2	CO-REQUISITE	AECC
7.	MSM 362	Dissertation 2	3	0	0	3	3	CO-REQUISITE	AECC
TOTAL			**18**	**5**	**3**	**26**	**25**		

[5] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Foundation Course in Mathematics (MSM 101)

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc.(H). (H)		**Academic Year: 2020-21**	
Branch: Maths, Physics, Chemistry		**Semester: I**	
1	Course Code	MSM 101	
2	Course Title	FOUNDATION COUSE IN MATHEMATICS	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	1. To familiarise the students with basic concepts of matrices, determinants and solving the system of linear equations. 2. To understand the basic concept of sets theory, co-ordinate geometry, complex number and vector algebra.	
6	Course Outcomes	CO1: Explain the concept of matrices and solve systems of linear equations and determinants. (K2,K3, K4) CO2: Explain the concept of complex numbers and calculate the nth roots of complex numbers and illustrate the solutions of simple Polynomial equations. (K2, K3, K4) CO3: Memorize the basic of Cartesian coordinate system and use algebraic techniques to explain intercepts and explore equations of lines on the number plane. (K1, K3, K4) CO4: Describe and differentiate the symmetries from graphs of conic sections. (K1, K2) CO5: Describe and use the concepts of set theory, relation and functions. (K1,K2,K3) CO6: Explain the basic concepts of vector algebra and use to find area of parallelogram and quadrilateral, Vector triple product.(K2,K 3,K4)	
7	Course Description	This course is an introduction to the fundamental of Mathematics. The primary objective of the course is to develop the basic understanding of linear algebra, complex number, co-ordinate geometry, sets theory and vector algebra.	
8	**Outline syllabus**	**Foundation course in Mathematics**	**CO Mapping**
	Unit 1	**Matrices**	
	A	Evaluation of determinants, Properties of determinants,	CO1
	B	Matrices: types of matrices, addition, subtraction and multiplication of matrices, symmetric and skew	CO1

		symmetric matrix. Inverse of matrix.			
	C	Rank of a matrix, Consistency of system of equations, Characteristic equation, Cayley -Hamilton theorem.			CO1
	Unit 2	**Complex Numbers**			
	A	Representation of complex number in Argand plane, Modulus and argument of complex number			CO2
	B	Algebraic operations, De- Moivre's theorem			CO2
	C	Nth root of complex number, Euler's formula			CO2
	Unit 3	**Co-ordinate geometry**			
	A	Cartesian coordinate system, Distance between two points Equations of line in various forms			CO3
	B	Equation of circle in various forms, Equation of tangent and normal to the circle.			CO3, CO4
	C	Equation of ellipse, parabola and hyperbola			CO3, CO4
	Unit 4	**Sets Theory**			
	A	Definition of set, types of sets, Union and intersection of sets, Venn diagram, De-Morgan's law.			CO5
	B	Relation and functions.			CO5
	C	Composite function and inverse function.			CO5
	Unit 5	**Vector Algebra**			
	A	Addition and subtraction of vectors and their geometric application.			CO6
	B	Scalar and vector product, their physical application, Projection of vector on another vector, area of triangle.			CO6
	C	Area of parallelogram and quadrilateral, Vector triple product.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley & Sons Inc. 1. Jain, M.K., and Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa Publications			
	Other References	1. Thomas, B.G., and Finny R.L., "Calculus and Analytical geometry", Pearson Education Asia, AdisonWisley. 2. Simmons, G.F., "Differential Equations with applications with applications", Tata McGraw-Hill.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C101.1	3	3	2	2	2	3	2	2	1	1
C101.2	2	3	3	2	2	2	1	2	1	1
C101.3	2	2	2	3	3	2	1	1	2	2
C101.4	2	3	2	2	2	2	1	2	2	2
C101.5	3	3	2	2	2	1	2	1	2	1
C101.6	3	3	2	3	2	2	1	2	2	1

Communicative English-1 (ARP 101)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H). (H)		**Academic Year: 2020-21**
Branch: Maths, Physics, Chemistry		**Semester: I**
1	Course Code	ARP101
2	Course Title	Communicative English-1
3	Credits	2
4	Contact Hours (L-T-P)	1-0-1
	Course Status	Compulsory
5	Course Objective	To minimize the linguistic barriers that emerge invaried sociolinguistics environments through the use of English. Help students to understand different accents and standardize their existing English. Guide the students to hone the basic communication skills - listening, speaking, reading and writing while also uplifting their perception of themselves, giving them self-confidence and building positive attitude.

6	Course Outcomes	CO1 Learn to use correct sentence structure and punctuation as well as different parts of speech. CO2 Learning new words its application and usage in different contexts helpful in building meaning conversations and written drafts. Develop over all comprehension ability, interpret it and describe it in writing. Very useful in real life situations and scenarios. CO2 A recognition of one's self and abilities through language learning and personality development training leading up to greater employability chances. Learn to express oneself through writing while also developing positive perception of self. To be able to speak confidently in English CO3 To empower them to capitalize on strengths, overcome weaknesses, exploit opportunities, and counter threats. To ingrain the spirit of Positive attitude in students through a full length feature film followed by a story boarding activity. Create a Self Brand, identity and self esteem through various interesting and engaging classroom activity CO4 Exposing students to simulations and situations wherein students learn to describe people and situations and handle such situations effectively and with ease. Teaching students how to engage in meaningful dialogues and active conversational abilities to navigate through challenging situations in life and make effective conversations. CO5 Learn how to transform adverse beginnings into positive endings – through writing activities like story completion.	
7	Course Description	The course is designed to equip students, who are at a very basic level of language comprehension, to communicate and work with ease in varied workplace environment. The course begins with basic grammar structure and pronunciation patterns, leading up to apprehension of oneself through written and verbal expression as a first step towards greater employability.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Sentence Structure	
	A	Subject Verb Agreement	CO1
	B	Parts of speech	CO1
	C	Writing well-formed sentences	CO1
	Unit 2	Vocabulary Building & Punctuation	
	A	Homonyms/ homophones, Synonyms/Antonyms	CO2
	B	Punctuation/ Spellings (Prefixes-suffixes/Unjumbled Words)	CO2
	C	Conjunctions/Compound Sentences	CO2
	Unit 3	Writing Skills	
	A	Picture Description – Student Group Activity	CO3
	B	Positive Thinking - Dead Poets Society-Full-length feature film -Paragraph Writing inculcating the positive attitude of a learner through the movie | SWOT Analysis – Know yourself	CO3

	C	Story Completion Exercise –Building positive attitude - The Man from Earth (Watching a Full length Feature Film)			CO3,CO4
	Unit 4	Speaking Skill			
	A	Self-introduction/Greeting/Meeting people – Self branding			CO4, CO5
	B	Describing people and situations - To Sir With Love (Watching a Full length Feature Film)			CO4, CO5
	C	Dialogues/conversations (Situation based Role Plays)			CO4
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		60%		40%	
	Text book/s*	• Blum, M. Rosen. How to Build Better Vocabulary. London: Bloomsbury Publication • Comfort, Jeremy(et.al). Speaking Effectively. Cambridge University Press			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C101.1	-	-	-	-	1	-	1	1	1	1
C101.2	-	-	-	-	-	-	1	1	1	2
C101.3	-	-	-	-	1	-	1	1	1	2
C101.4	-	-	-	-	1	-	1	1	1	2
C101.5	-	-	-	-	-	-	1	1	1	1

PHYSICAL CHEMISTRY-I (C) (BCH 101)

School: SBSR		**Batch :2020- 2023**
Program: B. Sc		**Academic Year: 2020-21**
Branch: Maths, Physics,Chemistry		**Semester: 1**
1	Course Code	BCH 101
2	Course Title	**PHYSICAL CHEMISTRY-I (C)**

3	Credits	4	
4	Contact Hours (L-T-P)	(3- 1- 0)	
	Course Status	Compulsory	
5	Course Objective	1. To provide the understanding of physical states of matter and how they are related to daily life application 2. To define how the initially primitive models of real gases in physical chemistry are elaborated to take into account more detailed observations. 3. To understand the laws of solid state chemistry and the arrangement of ions/atoms/molecules in a crystal lattice 4. To list different properties of liquids involving surface tension and viscosity coefficients. 5. To extend the concept of solutions from Raoult's Law to industrial application processes. 6. To provide the introduction and application of solid, liquid and gaseous states.	
6	Course Outcomes	CO1: The structural features of solid-state material by having the knowledge of packing arrangements. CO2: Different properties of liquids and their application in daily life. CO3: The separation processes of steam distillation and solvent extraction. CO4: Ideal and Non ideal gas behaviour and their properties. CO5: The basics of thermodynamics to the lab-scale heat exchange processes. CO6: Fundamental properties, thermodynamical properties and application of all states of mater	
7	Course Description	Course emphasizing on the various solid state structures and its correlation to atomic coordinated, distinguishing properties of liquid state, physical properties of molecule's in solutions and gaseous state, thermochemistry aspects of chemical process.	
8	Outline syllabus		CO Mapping
	Unit 1	**Solid State**	
	A	Crystalline and amorphous solids, crystal lattices and unit cell, Crystal systems, types, close packing,	CO1,CO6
	B	Packing fraction, crystal density, Ionic Radii, radius ratio. X–Ray diffraction: Bragg's law,	CO1,CO6
	C	Structures of NaCl, KCl and CsCl (qualitative treatment only). Point Defects. Glass and liquid crystals.	CO1,CO6
	Unit 2	**Liquid State**	
	A	Qualitative treatment of the structure of the liquid state, Radial distribution function	CO2,CO6
	B	Physical properties of liquids: vapour pressure, surface tension, coefficient of viscosity and their determination.	CO2,CO6
	C	Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity of liquids and comparison with that of gases.	CO2,CO6

	Unit 3	**Solution**			
	A	Deviations from Raoult's law – non-ideal solutions. Colligative properties: vapour pressure-composition and temperature composition curves of ideal and non-ideal solution, azeotropes, distillation of solutions.			CO3,CO6
	B	Partial miscibility of liquids: critical solution temperature, effect of impurity on partial miscibility of liquids.			CO3,CO6
	C	Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.			CO3,CO6
	Unit 4	**Gaseous State**			
	A	Kinetic theory of gases, derivation of Ideal gas equation, Maxwell distribution of molecular velocities and molecular energies, principle of equipartition of energy,			CO4,CO6
	B	Deviation of gases from ideal behaviour, compressibility factor (Z) and expansitivity factor, van der Waal's equation of state and its application to explain deviation of gases.			CO4,CO6
	C	Critical constant of gas in terms of van der Waal's constant: derivation of P_c, T_c and V_c, principle of corresponding states.			CO4,CO6
	Unit 5	**Thermodynamics and Thermochemistry**			
	A	Recapitulation of Laws of Thermodynamics, Entropy changes in reversible and irreversible processes, Entropy changes for an ideal gas in isothermal, isobaric and isochoric processes,			CO5,CO6
	B	Physical significance of entropy, Helmholtz free energy (A) and Gibbs free Energy (G), variation of Free Energy with pressure and temperature, Maxwell relations, Gibbs-Helmholtz equ.			CO5,CO6
	C	Relation between Enthalpy of reaction at constant volume and pressure, Enthalpy of formation, Kirchhoff equation, Hess's Law and application, measuring the enthalpy of combustion.			CO5,CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. P.W. Atkins and Julio de Paula, "Physical Chemistry", 8th Ed., W. H. Freeman Publication, 2006. 2. G.M. Barrow, "Physical Chemistry" Tata McGraw-Hill Education, 2008. 3. Puri, Sharma and Pathania, "Principles of Physical Chemistry" Vishal Publishing Co.			

		4. Bahl Arun, Bahl B.S. and J.D Tuli, "Essentials of Physical Chemistry", S.Chand & Co. 5. KL Kapoor , "Textbook of Physical Chemistry" Volume 1 and 2, Macmillan Publishers	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C101.1	2	2	2	2	1	1	1	2	1	2
C101.2	2	1	2	1	2	1	1	1	1	2
C101.3	1	2	1	1	2	2	2	1	2	1
C101.4	2	2	2	1	1	2	2	2	1	1
C101.5	2	1	2	2	2	1	1	2	2	2
C101.6	1	1	1	2	1	1	1	1	1	1

Mechanics and properties of matter (PHB 114)

School: SBSR		**Batch: 2020- 2023**
20Program: B.Sc.(H).		**Academic Year: 2020-21**
Branch: Physics		**Semester: I**
1	Course Code	PHB114
2	Course Title	Mechanics and properties of matter
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To make the students familiar with use of vector algebra to study mechanics. 2. To understand and appreciate the rotational and harmonic motion. 3. To know the elasticity of matter and bending of beams in different situation. 4. To understand the concept surface tension and viscosity.

6	Course Outcomes	After the completion of this course, the student will be able to CO1: understand the concept of motion, work, energy, momentum and frame of references CO2: appreciate real life applications of rotational mechanics and simple harmonic motion. CO3: use of moment of force and properties of matter to describe the elasticity and beam bending. CO4: understand the cause of capillarity, and surface tension and explain the of real life observations based on it CO5: understand the cause of viscosity and explain the real life observations based on it. CO6: appreciate mechanics with vector algebra and can apply it on real life problems	
7	Course description	This course is designed to make students proficient in mechanics, especially rotational mechanics with vector treatment. They also learn about certain properties of matter like elasticity, surface tension and viscosity.	
8	Outline Syllabus		CO Mapping
	Unit 1	Motion, Work, Energy and Momentum	
	A	Review of Vector Algebra, Concept of work, power and energy; Law of conservation of energy; Conservative forces	CO1, CO6
	B	Conservation law of momentum; Centre of mass; Collision of bodies	CO1, CO6
	C	Centre of mass frame of reference, Laboratory frame of reference	CO1, CO6
	Unit 2	Simple Harmonic Motion	
	A	Equation of Simple Harmonic Motion; Energy of a Harmonic Oscillator. Compound Pendulum	CO2, CO6
	B	Rigid body-Translational and rotational Motion, angular momentum, torque; Moment of Inertia-Radius of gyration	CO2, CO6
	C	Parallel and perpendicular theorems of Moment of Inertia, moment of inertia of disk, sphere, and rectangular lamina	CO2, CO6
	Unit 3	Elasticity & Bending of beams	
	A	Hooke's Law, Stress - Strain Diagram - Elastic moduli - Relation between elastic constants	CO3, CO6
	B	Poisson's Ratio – Determination of Poisson's ratio; Work done per unit volume in a strain	CO3, CO6
	C	Bending of beam; Bending moment, Cantilever	CO3, CO6
	Unit 4	Surface Tension	
	A	Surface Tension: Definition and dimensions of surface tension; Excess of pressure over curved surfaces	CO4, CO6

	B	Application to spherical and cylindrical drops and bubbles	CO4, CO6
	C	Variation of Surface tension with temperature, Jaegar's method	CO4, CO6
	Unit 5	Viscosity	
	A	Streamline Flow; Bernoulli's Theorem; Co-efficient of viscosity and its dimensions	CO5, CO6
	B	Rate of flow of liquid in a capillary tube - Poiseuilles' formula	CO5, CO6
	C	Variation of viscosity of a liquid with temperature	CO5, CO6
	Mode of Examination	Theory	
	Weightage Distribution	CA 30% / MTE 20% / ETE 50%	
	Text Book/s	1. Mechanics, D.S.Mathur, S.Chand & Co. (Text Book) 2. Properties of matter, D.S.Mathur, S.Chand & Co.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C114.1	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**2**
C114.2	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**2**
C114.3	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**
C114.4	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**1**
C114.5	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**
C114.6	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**

Introduction to 'C' Programming (CSE 115)

School: SBSR		Batch : **2020- 2023**
Program: B.Sc.(H).(H)		Academic Year:2020-21
Branch: Maths		Semester: I
1	Course Code	CSE115
2	Course Title	Introduction to 'C' Programming
3	Credits	4

4	Contact Hours (L-T-P)	3-1-0	
	Course Status		
5	Course Objective	To understand and demonstrate how to solve logical and scientific problems using programming.	
6	Course Outcomes	On successful completion of this module students will be able to: 1. Identify and understand the working of key components of a computer system. 2. Apply and practice logical ability to solve the problems. 3. Generate efficient and schematic solution to the problems.	
7	Course Description	To understand and demonstrate how to solve logical and scientific problems using programming.	
8	Outline syllabus		CO Mapping
	Unit 1	Basics of computers	
	A	Introduction to computers: Von- Neumann's Model, Components, Devices.	CO1, CO2
	B	Data representation in computers(Number,Character).	CO1, CO2
	C	Introduction to Softwares: System, Application	CO1, CO2
	Unit 2	Fundamental of Logic Buildings (Algorithms)	
	A	Problem Solving Aspects: Input, Output, Process(relationships between input and output), Verification, solve real life problems, case study examples.	CO1, CO2,CO3
	B	Type of constructs in algorithm to solve problem: Declaration, assignment, decision and control.	CO1, CO2,CO3
	C	Implementation of Algorithms: Computer Programming Evolution, Translators: Assembler, Compiler, Interpreter	CO1, CO2,CO3
	Unit 3	Basics of Flowcharts	
	A	Flowchart: Elements, need of input and output.	CO2,CO3
	B	Identifying and understanding input/output, branching and iterations in flowchart.	CO2,CO3
	C	Conversion of algorithms in flowchart.	CO2,CO3
	Unit 4	C Language-I	
	A	Introduction to C programming language: Structure of a C program.	CO3
	B	Compilation and execution of C program. Data types, Variables, Constants, Identifiers and keywords, Operators.	CO2,CO3
	C	Types of Statements: Assignment, Control, jumping.	CO2,CO3
	Unit 5	C Language-II	
	A	Control statements: Decisions, Loops, break,	CO2,CO3

		continue			
	B	Nesded Loop			CO2,CO3
	C	Arrays: One dimensional Array, Sorting, Searching			CO2,CO3
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Yashavant Kanetkar, "Let Us C", BPB.			
	Other References	1. Byron Gottfried, "Programming with C",TMH. 2.R. G. Dromey, "How to Solve It by Computer",Pearson.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C115.1	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
C115.2	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**2**
C115.3	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**

OPTICS (PHB 115)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H).		**Academic Year: 2020-21**
Branch: Maths		**Semester: II**
1	Course Code	PHB-115
2	Course Title	OPTICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	This course provides the knowledge of fundamental concepts of optics and understanding of wave and optics phenomena, with emphasis on everyday effect.
6	Course Outcomes	CO1: Apply the laws and concepts of geometrical optics to find cardinal points and solve a variety of numerical problems. CO2: Understand the concepts and phenomena of wave optics and analyze the intensity variation of light due to interference. CO3: Understand the concepts of diffraction and analyze the intensity variation of light due to single slit, double slits and N-slits diffraction. CO4: Understand mean of resolution and working of telescope and microscope.

		CO5: Understand optical phenomena in terms of electromagnetic wave properties including polarization of light and its applications. CO6: Apply conceptual understanding and mathematical methods to solve the problems.	
7	Course Description	This course provides students with an understanding of optical phenomena based on the wave description of light. The geometrical optics and principles of polarization, interference and diffraction and optical devices that use these properties of light will be described.	
8	Outline syllabus		CO Mapping
	Unit 1	**Geometrical Optics**	
	A	Cardinal Points of an Optical System (six points), Newton's formula	CO1, CO6
	B	Nodal slide, Coaxial Lens System(equivalent focal length and cardinal points)	CO1
	C	Huygens Eyepiece, Ramsden Eyepiece and their cardinal points	CO1, CO6
	Unit 2	**Interference**	
	A	Introduction, Coherent sources, Concept of spatial and temporal coherence, Interference of light	CO2, CO6,
	B	Division of wave front: Young's Double slit experiment and Fresnel's bi-prism	CO2, CO6
	C	Division of amplitude: Interference in thin films, wedge shaped films, Newton's rings.	CO2, CO6,
	Unit 3	**Diffraction**	
	A	Introduction, Fresnel and Fraunhoffer diffraction,	CO3
	B	Fraunhoffer diffraction due to single slit, double slit	CO3,CO6
	C	n slits diffraction, Plane diffraction grating	CO3, CO6
	Unit 4	**Resolving power**	
	A	Resolving power, Rayleigh criteria	CO4
	B	Resolving power of diffraction grating	CO3,CO4, CO6
	C	Resolving power of microscope, telescope	CO4,CO6
	Unit 5	**Polarization**	
	A	Phenomenon of polarization, Production of polarized light by reflection, refraction, Brewster's law, Malus law,	CO5
	B	Nicol prism, Polarization by double refraction Retardation plates (Quarter and half wave plates), production and analysis of circularly and elliptically polarized light	CO5, CO6
	C	Optical activity and Fresnel's theory of optical	CO5, CO6

		rotation, specific rotation, polarimeter			
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Optics by Brijlal and Subrahmanyam 2. Optics by Vasudeva			
	Other References	1. Optics by A. K.Ghatak 2. Principles of Optics, B.K. Mathur, New Global Printing Press, Kanpur 3. Fundamentals of Optics - F.A. Jenkins and H.E. White ((McGraw Hill) 4. Principles of Optics, M. Born and E. Wolf, Sixth Edition, Pergamon Press, Oxford			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C115.1	2	2	2	1	1	2	2	1	2	1
C115.2	2	2	2	1	2	3	2	1	2	1
C115.3	2	2	2	1	1	2	2	1	2	1
C115.4	2	2	2	1	1	3	2	1	2	1
C115.5	2	2	2	2	1	2	2	1	2	1
C115.6	2	2	2	1	1	3	2	1	2	1

Organic Chemistry-1 (C) (BCH 102)

School: SBSR		**Batch : 2020- 2023**
Program: B. Sc(H)		**Academic Year: 2020-21**
Branch: Maths		**Semester: II**
1	Course Code	BCH 102
2	Course Title	**Organic Chemistry-1 (C)**
3	Credits	4
4	Contact Hours (L-T-P)	(3- 1- 0)
	Course Status	Compulsory
5	Course Objective	1. To introduce students to many of the key concepts of organic chemistry through a survey of the basic reactions types.

		2. To promote understanding of basic facts and concepts and to inculcate interest in Organic chemistry. 3. To elaborate various electronic factors, an understanding of nucleophiles, electrophiles, electronegativity, and resonance, reaction intermediates and their effect on the course of organic reactions. 4. To discuss the theories of organic acids/bases, the concept of Formal charges and Curley Arrow rule. 5. To explain, classify and apply fundamental organic reactions such as SN2, SN1, E2, E1, alkene addition, electrophilic aromatic substitution, 1,2/1,4-additions to organic molecules. 6. To elaborate logical and detailed mechanisms for various fundamental reactions which involves nomenclature, physical properties, synthesis, reactions, of alkanes, alkenes, dienes, and alkynes. 7. To demonstrate the basics of Stereochemistry, Classify molecules as chiral or achiral, identify chiral carbons as (R) or (S), identify relationships between pairs of molecules as enantiomers, diastereomers, or equivalent, and identify when a solution is racemic versus optically active. 8. To provide knowledge of basics of organic chemistry, alkanes and cycloalkanes, alkenes and dienes, alkynes and stereochemistry.	
6	Course Outcomes	Students will be able to: CO1: explain many concepts like electronic displacement, bond fission, Reaction intermediates, curly arrow rule, nucleophilicity etc. CO2: understand the synthesis, reactions of alkanes, cycloalkanes and their mechanism CO3: explain the synthesis, reactions of alkenes and dienes CO4: summarize the physical and chemical properties of alkynes CO5: explain and apply the concept of stereoisomerism and conformation CO6: apply the basic concept of organic chemistry in synthesis & reactions of hydrocarbons and analyze the stereochemistry of hydrocarbons	
7	Course Description	Course emphasizing basic organic chemistry which encompasses various types of electronic displacement, reaction intermediates. Further this course enables the students to generalize the structure properties relationship of Alkanes, alkenes, alkynes and cycloalkane. It also gives in-depth idea to prepare various above compounds by different methods. It also covers the basic information about stereoisomerism.	
8	Outline syllabus		CO Mapping
	Unit 1	**Basics of Organic Chemistry**	
	A	Electronic Displacements- Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and	CO1, CO6

		their applications; Homolytic and Heterolytic fission with suitable examples,	
	B	Reaction Intermediates types, shape and relative stability of carbocations, carbanions, free radicals and carbenes Dipole moment; Organic acids and bases; their relative strength..	CO1, CO6
	C	Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity. Introduction to types of organic reactions and their mechanism: Addition, Elimination, Substitution and rearrangement reactions.	CO1, CO6
	Unit 2	**Alkanes and Cycloalkanes**	
	A	Alkanes- Methods of synthesis (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids & their salts)	CO2, CO6
	B	Chemical reactions: Nitration, Halogenation, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.	CO2, CO6
	C	Cycloalkanes- Nomenclature, synthesis, relative stability- Baeyer Strain Theory, physical properties & Chemical properties.	CO2, CO6
	Unit 3	**Alkenes and Dienes**	
	A	Methods of synthesis, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination,	CO3, CO6
	B	Relative stabilities of alkenes Chemical reactions – hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration, oxidation, oxymercuration-reduction.	CO3, CO6
	C	Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization. Dienes, Relative stability of dienes, Conjugated dienes, 1,2 and 1,4 additions.	CO3, CO6
	Unit 4	**Alkynes**	
	A	Methods of synthesis, chemical reactions, acidity of terminal alkynes,	CO4, CO6
	B	Mechanism of electrophilic and nucleophilic addition reactions	CO4, CO6
	C	Hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.	CO4, CO6
	Unit 5	**Stereochemistry**	
	A	Concept of isomerism and its types, Projection: Newman projection and Sawhorse formulae, Fischer and flying wedge formulae and their interconversion, Difference	CO5, CO6

		between conformation and configuration.			
	B	Conformational isomerism in ethane, n-butane and unsubstituted cyclohexane (axial and equatorial bonds), Optical isomerism –Molecular chirality, enantiomers, stereogenic center, optical activity, chiral and achiral molecules with one & two stereogenic centers			CO5, CO6
	C	Disasteromers, meso compounds, Absolute configuration, sequence rules, R & S systems of nomenclature. Geometric isomerism – cis/trans, E/Z system of nomenclature, geometric isomerism in alicyclic compounds.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Organic Chemistry by Solomon & Fryhle. 2. Advanced Organic Chemistry by Bahl and Bahl. 3. Organic Chemistry by Morrison and Boyd. 4. Stereochemistry of carbon compounds; E. L. Eliel. 5. Stereo Chemistry: Conformation and Mechanism; D. Nasipuri. 6. Stereochemistry: conformation and Mechanism; P. S. Kalsi. 7. Conformational analysis; Eliel, Allinger, Angyal and Morrison.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C102.1	2	2	2	1	1	2	2	1	2	1
C102.2	2	2	2	1	2	3	2	1	2	1
C102.3	2	2	2	1	1	2	2	1	2	1
C102.4	2	2	2	1	1	3	2	1	2	1
C102.5	2	2	2	2	1	2	2	1	2	1
C102.6	2	2	2	1	1	3	2	1	2	1

Thermal Physics (PHB 117)

School: SBSR		**Batch: 2020- 2023**	
Program: B.Sc.(H).(H)		**Academic Year: 2020-21**	
Branch: Maths		**Semester: II**	
1	Course Code	PHB117	
2	Course Title	Thermal Physics	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	To make students aware of concept of heat, temperature and heat flow. To teach students the thermodynamics of various engines To impart the knowledge of entropy and second law of thermodynamics. To differentiate the ideal gas from real gas behavior. To learn to derive and use thermodynamic equations.	
6	Course Outcomes	After the completion of this course, the student will be able to CO1: understand the importance of Zeroth law and concept of temperature. CO2: appreciate second law of thermodynamics and understand the thermodynamics of engines. CO3: know the concept of entropy and second law of thermodynamics. CO4: differentiate real gases from ideal gases and will know special properties of real gases. CO5: understand Maxwell's thermodynamic equations and will be able to apply them on some real life problems. CO5: appreciate the laws of thermodynamics and will understand how the things behave thermodynamically. CO6: apply thermodynamic principle on various practical and research problems.	
7	Course Description	This course is designed to teach students the basic laws of thermodynamics, thermodynamic potentials and behavior of ideal and real gases.	
8	Outline Syllabus		CO Mapping
	Unit 1	**Zeroth and first law of thermodynamics**	
	A	Thermodynamic Equilibrium; Zeroth Law of Thermodynamics and Concept of Temperature	CO1
	B	Work and Heat Energy; First Law of Thermodynamics; Applications of First Law	CO1
	C	General Relation between Cp and Cv; Work Done during Isothermal and Adiabatic Processes.	CO1
	Unit 2	**Second law of thermodynamics**	

	A	Limitations of first law of thermodynamics, Reversible and Irreversible Processes	CO2, CO6
	B	Heat Engines; Carnot Cycle; Carnot Engine and its Efficiency; Refrigerator and its Efficiency; Otto engine	CO2, CO6
	C	Kelvin-Planck and Clausius Statements and their Equivalence; Carnot Theorem; Second Law of Thermodynamics; Thermodynamic Scale of Temperature	CO2, CO6
	Unit 3	**Entropy**	
	A	Entropy of a State; Clausius Theorem; Clausius Inequality; Second Law of Thermodynamics in terms of Entropy	CO3
	B	Entropy of a Perfect Gas; Entropy Changes in Reversible and Irreversible Processes; Principle of Increase of Entropy	CO3
	C	Third Law of Thermodynamics; Temperature-Entropy Diagrams	CO3
	Unit 4	**Real gases**	
	A	Behavior of Real Gases; Deviations from the Ideal Gas Equation; The Virial Equation; Andrew's Experiments on CO_2 Gas	CO4, CO6
	B	Critical Constants; Continuity of Liquid and Gaseous State; Vapour and Gas; Boyle Temperature; Van der Waal's Equation of State for Real Gases; Values of Critical Constants; P-V Diagrams	CO4, CO6
	C	Joule-Thomson Porous Plug Experiment; Joule-Thomson Effect for Real and Van der Waal Gases; Temperature of Inversion; Phase transformation	CO4, CO6
	Unit 5	**Thermodynamic Equations**	
	A	Extensive and Intensive Thermodynamic Variables; Thermodynamic Potentials U; H; F and G; Their Definitions	CO5, CO6
	B	Properties and Applications; Derivations of Maxwell's Relations; Applications of Maxwell's Relations: (1) Clausius Clapeyron equation; (2) Values of Cp-Cv; (3) Tds Equations	CO5, CO6
	C	(4) Joule-Kelvin Coefficient for Ideal and Van der Waal Gases; (5) Energy Equations (6) Cooling due to Adiabatic demagnetization; Approach to Absolute Zero	CO5, CO6
	Mode of Examination	Theory	
	Weightage Distribution	CA 30% / MTE 20% / ETE 50%	
	Text Book/s	Heat and thermodynamics by Brijlal and Subrahmanyan, S.Chand $ co.	
	Other References	1. A Treatise on Heat ; Including Kinetic Theory of Gases; Thermodynamics and Recent Advances in Statistical Thermodynamics By Meghnad Saha; B; N; Srivastava (Indian Press; 1958) 2. Heat and Thermodynamics; An Intermediate Textbook By Mark Waldo Zemansky; Richard Dittman (McGraw-Hill; 1981) (Text Book) 3. Thermal Physics by Garg; Bansal and Ghosh (Tata McGra-Hill; 1993)	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C117.1	2	2	2	2	2	2	1	1	2	1
C117.2	1	2	1	2	1	1	2	1	1	2
C117.3	2	1	2	1	2	2	1	2	2	1
C117.4	2	2	1	2	2	1	1	1	1	2
C117.5	1	2	2	2	2	2	2	1	2	1
C117.6	2	2	2	2	2	1	1	1	1	2

Environmental Science (EVS 106)

School:		**Batch : 2020- 2023**
Program:		**Academic Year: 2020-21**
Branch: All		**Semester: II**
1	Course Code	**EVS-106**
2	Course Title	Environmental Science
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	1. Enable students to learn the concepts, principles and importance of environmental science 2. Provide students an insight of various causes of natural resource depletion and its conservation 3. Provide detailed knowledge of causes, effects and control of different types of environmental pollution and its effect on climate change, global warming and ozone layer depletion. 4. Provide knowledge of different methods of water conservation 5. Provide and enrich the students about social issues such as R&R, population and sustainability.

6	Course Outcomes	CO1.Understand the principles and scope of environmental science CO2. Study about various pollution causes, effects and control and solid waste management. CO3. Effect of global warming and ozone layer depletion CO4. Knowledge about various types of natural resources and its conservation CO5. Understand about sustainable development, resettlement and rehabilitation, impact of population explosion on environment the methods of water conservation CO6. Overall understanding of various environmental components, its protection and management.	
7	Course Description	Environmental Science emphasizes on various factors as 1. Importance and scope of environmental science 2. Natural resource conservation 3. Pollution causes, effects and control methods 4. Social issues associated with environment	
8	Outline syllabus		CO Mapping
	Unit 1	**General Introduction**	
	A	Definition, principles and scope of environmental science	CO1/CO6
	B	Land resources, Forest Resources	CO1/CO6
	C	Water Resources ,Energy Resources	CO1/CO6
	Unit 2	**Environmental Pollution (Cause, effects and control measures) and solid waste management**	
	A	Air pollution ,Water Pollution	CO2/CO6
	B	Soil and Noise pollution	CO2/CO6
	C	Solid wastes and its management	CO2/CO6
	Unit 3	**Climate Change and its impact**	
	A	Concept of Global Warming and greenhouse effect	CO3/CO6
	B	Ozone layer Depletion and its consequences	CO3/CO6
	C	Climate change and its effect on ecosystem, Kyoto protocol and IPCC concerns on changing climate	CO3/CO6
	Unit 4	**Natural resource conservation**	
	A	Hot spots, threats to biodiversity, endemic species	CO4/CO6
	B	Conservation of biodiversity, ex-situ, in-situ conservation, biodiversity services.	CO4/CO6
	C	Need of Water Conservation, Rain Water Harvesting Watershed management	CO4/CO6
	Unit 5	**Social Issues and the Environment**	

	A	Concept of sustainable development			CO5/CO6
	B	Resettlement and rehabilitation of people; its problems and concerns, Case studies			CO5/CO6
	C	Population explosion and its consequences			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Joseph, Benny, "Environmental Studies", Tata Mcgraw-Hill.			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

CO↓ PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C106.1	1	1	2	1	2	1	2	1	1	1
C106.2	1	1	2	1	2	1	2	2	1	1
C106.3	1	2	1	2	1	1	1	2	1	2
C106.4	2	1	2	1	2	1	2	1	1	2
C106.5	1	2	1	2	1	2	1	2	1	1
C106.6	2	1	2	1	2	2	1	2	2	1

Calculus I (MSM 105)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: II**
1	Course Code	MSM 105
2	Course Title	Calculus-I
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory

5	Course Objective	To make students familiar with the concepts of successive differentiation along with the concepts of partial differentiation, basic integration & multiple integration. A brief of first order ordinary differential equation has been also introduced.	
6	Course Outcomes	CO1: Memorize the basic of differentiation & Successive differentiation and solve with Leibnitz's theorem. (K1, K3) CO2: Explain and solve the Taylor's theorem, Maclaurin's theorem of one variable & two variables, Maxima minima for one & two variables, Lagrange's multipliers method and point of inflexion for various functions. (K1, K2, K3) CO3: Describe the Partial differentiation, Homogeneous functions and drive Euler's theorem with applications and apply the concept of Jacobian and its applications. (K1, K2, K3,) CO4: Memorize the basics of Integration with by parts method, partial fraction, Definite integration & its properties and evaluate the Beta and Gamma function. (K1, K3, K6) CO5: Evaluation of double integrals, Change of order of integration, change of variables, Area bounded by the curves, evaluation of triple integrals and its applications. (K1, K6) CO6: Formulate and evaluate first order differential equation. (K2, K5, K6)	
7	Course Description	This course is an introduce the concepts of successive differentiation along with the concepts of partial differentiation, basic integration & multiple integration. A brief of formulation and evaluation of first order differential equation.	
8	Outline syllabus : **Calculus I**		CO Mapping
	Unit 1	**DIFFERENTIATION**	
	A	Concepts of limit, continuity and differentiability, differentiation of standard functions, product and quotient rule for differentiation, chain rule	CO1
	B	Successive differentiation and its applications, Leibnitz's theorem	CO1
	C	Taylor's theorem, Maclaurin's theorem, Maxima-minima, Points of inflexion	CO2
	Unit 2	**PARTIAL DIFFERENTIATION**	
	A	Partial differentiation, homogeneous functions, Euler's	CO3

		theorem			
	B	Jacobian of explicit and implicit functions and its applications, Taylor's expansion in two variables			CO3
	C	Maxima-minima in two variables, Lagrange's multipliers method			CO2
	Unit 3	**INTEGRATION**			
	A	Integration of standard functions, integration by parts, by substitution			CO4
	B	Partial fractions, Definite integrals and its properties			CO4
	C	Beta and Gamma functions.			CO4
	Unit 4	**MULTIPLE INTEGRATION**			
	A	Evaluation of double integrals			CO5
	B	Change of order of integration, change of variables			CO5
	C	Area bounded by the curves, evaluation of triple integrals and its applications			CO5
	Unit 5	**ORDINARY DIFFERENTIAL EQUATIONS**			
	A	Formation of an ODE , Order and degree of an ODE			CO6
	B	First order differential equation and methods of solution including variable separable, homogeneous			CO6
	C	Exact differential equations, linear first order ODE,Equation reducible to exact differential equation.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Kreyzig, E., "Advanced Engineering Mathematics", John Willey & Sons.			

	Other References	2. Jain, M.K. and Iyenger, S.R.K., "Advanced Engineering Mathematics", Narosa Publications. 3. Thomas, B.G., and Finny R.L., "Calculus and Analytical Geometry", Pearson education Asia, Adison Wesley. 4. Simmons G.F., "Differential Equations with applications", Tata McGraw Hill.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C105.1	3	3	2	2	2	3	2	2	1	1
C105.2	2	3	3	2	2	2	2	2	1	2
C105.3	2	2	2	3	3	2	1	1	2	2
C105.4	2	3	2	3	2	2	1	2	2	2
C105.5	3	3	2	2	2	1	2	1	2	1
C105.6	3	3	3	3	3	3	2	1	2	1

BIO-STATISTICS (MTH-215)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc.		**Academic Year: 2020-21**
Branch: Chemistry/Bio-chemistry		**Semester: II**
1	Course Code.	MTH215
2	Course Title	BIO-STATISTICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course status	Elective
5	Course Objectives	To make students familiar with the concept of Probability and Statistics with emphasis on some standard probability distributions and sampling distributions.

6	Course Outcomes	CO1:Describe the concept of Statistics and statistical inference and calculate find the measures of central tendency and dispersion of a data. (K1,K2,K3) CO2: Explain the concept of probability and evaluate the probability of various events in a random experiment, theorem on probability, conditional probability. (K2,K4,K5) CO3: Discuss the concept of normal distributions for evaluate relevant probabilities. (K1,K2,K5) CO4: Discuss about confidence interval and evaluate population parameters from the statistics of samples.(K1,K2,K5) CO5: Explain and evaluate statistical hypothesis using large and small samples. (K2,K4,K5) CO6: Describe and evaluate coefficient of correlation, rank correlation and regression lines relating two variables. (K1,K2,K5)
7	Course Description	In this introductory statistics course we will explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations. We will cover descriptive statistics, probability, and hypothesis testing and statistical inference, correlation and regression techniques.
8	Outline syllabus:	

UNIT 1	**Introduction and descriptive statistics.**	CO Mapping
A	Some basic concepts – sampling and statistical inference	CO1
B	Frequency distribution. Measures of central tendency – mean, median, mode, mean of the combined data.	CO1
C	Dispersion – mean deviation, variance, standard deviation, quartiles.	CO1
UNIT 2	**Probability.**	
A	Objective and subjective views on probability. Random experiment, sample space, events, mutually exclusive events, independent events, axioms of probability, conditional probability.	CO2
B	Calculation of probabilities using addition theorem and conditional probability theorems.	CO2
C	Normal distribution: use of tables to calculate probabilities and also the mean and SD of normal distribution with given probabilities.	CO2, CO3
UNIT 3	**Estimation.**	
A	Confidence interval of a population mean.	CO4
B	Use of the t distribution in the estimation of population mean in the small sample cases.	CO4
C	Estimation of proportions.	CO4
UNIT 4	**Testing of hypothesis.**	
A	Testing of hypothesis: single population mean and difference of two population means.	CO5
B	Testing of hypothesis: single population proportion.	CO5
C	Chi – square test – goodness of fit.	CO5
UNIT 5	**Correlation and regression.**	

A	Carl Pearson's Coefficient of correlation.			CO6
B	Rank correlation.			CO6
C	Regression lines.			CO6
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics".		
	Other references	1. Daniel,WayneW.,"Biostatistics": Basic concept and Methodology for Health Science. 2. Grewal,B.S, "Higher Engineering Mathematics".		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C215.1	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**
C215.2	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**
C215.3	**2**	**2**	**2**	**3**	**3**	**2**	**1**	**1**	**2**	**2**
C215.4	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C215.5	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**
C215.6	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**

Linear Algebra (MSM 106)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc.(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: II**
1	Course Code.	MSM 106
2	**Course Title**	**LINEAR ALGEBRA**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0

	Course status	Compulsory	
5	Course Objective	To familiarise students with basics algebra of matrices, and its applications, vector space, Linear transformation and its properties, matrix representation of a linear transformation.	
	Course Outcomes	CO1: Describe the concept of algebra of matrices and elementary row operations and calculate the rank of matrix and analyse consistency of a linear system. (K1, K2, K3, K4) CO2: Calculate the eigenvalues, eigenvectors, diagonalization of a matrix. (K2, K3) CO3: Explain and illustrate Cayley - Hamilton theorem and its applications. (K2,K3, K4). CO4: Discuss vector space and subspace, explain linear dependence and independence of vectors and calculate linear span, basis and dimension, sums and direct sums. (K2, K3, K4) CO5: Discuss about linear transformation and its properties, range and kernel of a linear transformation, calculate the rank and nullity of linear transformation and drive Rank-nullity theorem and explain inverse of linear transformation, operations with linear transformations.(K2, K3, K4) CO6: Explain matrix representation of a linear transformation and general linear transformations; evaluate change of basis, similarity of matrices. (K 4, K6)	
7	Course Description	This course is an introduce basics algebra of matrices, and its applications, vector space, Linear transformation and its properties, matrix representation of a linear transformation.	
8	Outline syllabus	Linear Algebra	CO Mapping
	Unit 1	**Algebra of matrices-1**	
	A	Algebra of matrices, elementary row operations	CO1
	B	Row reduced Echelon form, rank of a matrix	CO1
	C	Consistency of a linear system, inverse of a matrix (using elementary row operations.	CO1
	Unit 2	**Algebra of matrices-2**	
	A	Eigenvalues and eigenvectors	CO2
	B	Diagonalization of a matrix	CO2
	C	Cayley - Hamilton theorem (without proof) and its applications	CO3
	UNIT 3	**Vector Spaces**	
	A	Vector space and subspace of vector space.	CO4
	B	Linear dependence and independence of vectors, linear span.	CO4
	C	Basis and dimension, sums and direct sums.	CO4
	Unit 4	**Linear Transformation- 1**	
	A	Linear transformation and its properties.	CO5

	B	Range and kernel of a linear transformation, rank and nullity of linear transformation.			CO5
	C	Rank-nullity theorem, inverse of linear transformation, operations with linear transformations.			CO5
	Unit 5	**Linear Transformation- 2**			
	A	Matrix representation of a linear transformation			CO6
	B	Change of basis, similarity			CO6
	C	Matrices and general linear transformations.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Hoffman, K &Kunze, R. , Linear Algebra, 2nd edition, Prentice Hall of India, 1975. 2.Lipshutz, S., Lipsom, M., Linear algebra, 3rd edition, Schaum series, 2001.			
	Other References	1. Strang, G., Linear Algebra and its applications, 3rd edition, Thomson,1998. 2. Kreyszig , E., Advanced Engineering Mathematics, John Wiley & Sons. 3. V. Krishnamurthy, V.P. Mainra and J.L. Arora: An Introduction to Linear Algebra.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C106.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C106.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C106.3	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**
C106.4	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C106.5	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**1**	**2**	**1**
C106.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**2**	**2**

Calculus II (MSM 204)

School: SBSR		**Batch : 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: III**
1	Course Code	MSM 204
2	**Course Title**	**Calculus- II**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To make students familiar with the advancement of calculus. The concept of Laplace transform, Fourier series, Vector differentiation & Vector Integration along with the brief of Z-transform has been introduced.
6	Course Outcomes	CO1: Explain and illustrate the concepts of vector differentiability of function along with its applications. (K2, K3, K4) CO2: Describe the properties of divergence and curl; evaluate irrotational and solenoidal vector fields. (K1, K2, K3, K5) CO3: Describe line integral, surface integral, and volume integral,explain its application and Gauss divergence theorem, Stoke's theorem and Green's theorem. (K2, K3, K4) CO4: Describe Laplace Transform of some standard functions & Inverse Laplace transform & explain its application and solve linear differential equations. (K2, K3, K4) CO5: Describe the Fourier Series and evaluate the expansion of functions in terms of Fourier series. (K2, K3, K6) CO6: Describe and analyze the basic concepts of Z-transform and it's application. (K1,K2, K4)
7	Course Description	This course is an initiate the advancement of calculus. The primary objective of the course is to develop the basic understanding of the concept of Laplace transform, Fourier series, Vector differentiation & Vector Integration along with the brief introduction of Z-transform.

8	Outline syllabus : **Calculus-II**		CO Mapping
	Unit 1	**Vector Differentiation:**	
	A	Vector and scalar fields, gradient, level surfaces, normal to a surface,	CO1
	B	directional derivative, angle between two surfaces, definitions of divergence and curl,	CO1
	C	Properties of divergence and curl, irrotational and solenoidal vector fields.	CO2
	Unit 2	**Vector Integration:**	
	A	Line integral, surface integral,	CO3
	B	Volume integral, applications of Gauss divergence theorem (Without proof),	CO3
	C	Stoke's theorem (Without proof) and Green's theorem (Without proof).	CO3
	Unit 3	**LAPLACE TRANSFORMATION**	
	A	Laplace transform of some standard functions, theorems and properties on Laplace transforms	CO4
	B	Inverse Laplace transformation	CO4
	C	Convolution theorem and application to solve simple linear differential equations	CO4
	Unit 4	**FOURIER SERIES**	
	A	Periodic function, Fourier series of period 2pi	CO5
	B	Change of interval	CO5
	C	Even and odd functions, Half range sine and cosine series	CO5
	Unit 5	**Z Transform:**	
	A	Definition of Z transform, examples of Z transform,	CO6
	B	properties of Z transform, Inverse Z transform, Convolution theorem,	CO6

	C	Application to solve simple difference equations.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Kreysig, E., "Advanced Engineering mathematics", John Willey & Sons			
	Other References	2. Jain, M.K. and Iyenger, S.R.K., "Advanced Engineering mathematics", Narosa Publications. 3. Thomas, B.G., and Finny R.L., "Calculus and Analytical geometry", Pearson Education Asia, Adison Wisley.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C204.1	3	3	2	2	2	3	2	2	1	1
C204.2	2	3	3	3	2	2	2	2	1	2
C204.3	2	3	2	2	3	2	1	1	2	2
C204.4	2	2	2	3	2	2	1	2	2	2
C204.5	3	2	2	3	2	1	2	1	2	1
C204.6	3	3	2	2	3	3	2	1	2	1

Inorganic Chemistry-I (BCH 201)

School: SBSR	**Batch : 2020- 2023**
Program: B.Sc.(H).(H)	**Academic Year: 2021-22**
Branch: Mathematics	**Semester: III**

1	Course Code	BCH 201	
2	Course Title	Inorganic Chemistry-I	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory /Elective/Open Elective	
5	Course Objective	1. To provide the basics of structure of atoms and the basics of theories involve there in. 2. To introduce the concept of ionic bonding of solids and the different factors that affect ionic bonding. 3. To illustrate the importance of covalent bonding and its usefulness in predicting fundamental properties of the molecules. 4. To explain to the student about shapes of a covalent molecule 5. To provide an introduction to the basic concepts in Molecular Orbital Theory and apply them to understand and compare the stability and reactivity of the molecules. 6. To introduce other types of non-covalent interaction that could be present in a molecule.	
6	Course Outcomes	The student will be able to CO1 :understand the various theories to describe atomic structure CO2 :know about ionic bonding, significance and factors affecting the strength of ionic bonding CO3: explain the basis of covalent bonding in molecules CO4 : explain the basics of M.O Theory CO5: explain about band theory of solids and non-covalent interactions present in them CO6 :gain insight about various ionic, covalent and non-covalent interactions that are present in the molecule and their structural studies	
7	Course Description	This course describes the basic theories involved in atomic structure and chemical bonding. This course satisfies the requirement of B.Sc.(H) chemistry honors' programme.	
8	Outline syllabus		CO Mapping
	Unit 1	**Atomic Structure**	
	A	Bohr's theory, its limitations and atomic spectrum of hydrogen atom.	CO1, CO6
	B	Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom.	CO1, CO6
	C	Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its	CO1, CO6

		limitations,			
	Unit 2	**Chemical Bonding-I**			
	A	Ionic bond and factors affecting ionic bond; lattice energy and its calculation by Born-Haber cycle.Madelung constant,			CO2, CO6
	B	solvation energy, factors affecting solvation energy and solubility of ionic solids.			CO2, CO6
	C	Polarizing power and polarizability; Ionic Potential, Fajan's rules.			CO2, CO6
	Unit 3	**Chemical Bonding-II**			
	A	Covalent bonding: Concept of Hybridization, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3).			CO3, CO6
	B	Bent's Rule, Resonance in Inorganic molecules and ions, VSEPR theory, Shortcomings of VSEPR theory,			CO3, CO6
	C	Prediction of structures and variation of bond angles on the basis of VSEPR theory, prediction of hybridization and shapes of simple inorganic molecules and ions such as NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, and H_2O by valence shell electron pair repulsion (VSEPR) theory.			CO3, CO6
	Unit 4	**Chemical Bonding-III**			
	A	Valence bond theory - A mathematical approach and its limitations, directional characteristics of covalent bond. Molecular orbital theory (LCAO method)			CO4, CO6
	B	Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules,			CO4, CO6
	C	Molecular orbital energy level diagrams (He_2, B_2, C_2, Be_2, N_2, O_2, F_2, NO, CO, HF, CN^-), Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules.			CO4, CO6
	Unit 5	**Chemical Bonding-IV**			
	A	Polar covalent bonds, Dipole moment.			CO5,CO6
	B	Hydrogen bonding and its effect on the physical and chemical properties of compounds of the main group elements. van der Waal's forces (dipole-dipole interactions, ion-dipole interactions, ion-induced dipole interactions)			CO5,CO6
	C	Metallic bonding: Band theory and its illustration.			CO5,CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**References** 1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.			
	Other	1. Douglas, B.E. and McDaniel, D.H. *Concepts &*			

	References	*Models of Inorganic Chemistry* Oxford, 1970 2. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014. 3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962. 5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C201.1	2	2	2	2	2	2	1	1	2	1
C201.2	1	2	1	2	1	1	2	1	1	2
C201.3	2	1	2	1	2	2	1	2	2	1
C201.4	2	2	1	2	2	1	1	1	1	2
C201.5	1	2	2	2	2	2	2	1	2	1
C201.6	2	2	2	2	2	1	1	1	1	2

Electricity and Magnetism (PHB219)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H). (Hons)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: III**
1	**Course Code**	**PHB 219**
2	**Course Title**	**Electricity and Magnetism**
3	**Credits**	**4**
4	**Contact Hours (L-T-P)**	**3-1-0**
	Course Status	**Compulsory**
5	**Course Objective**	This course aims to establish a foundation in electromagnetism and to make the students learn fundamental concepts of electricity, magnetism and circuit theory to use them in real life problems.
6	**Course Outcomes**	**On successful completion of this course students will /will be able to:** **CO1:** Understand Coulomb's Law of force, Electric field, Gauss Law and will solve problems based on it, Electric potential and electrostatic energy. **CO2:** Distinguish different types of capacitors and derive energy stored in a capacitor, force of attraction between capacitor plate. **CO3:** Learn magnetic effect of current, definition of **B**, magnetic flux density, Bio-Savart's Law, Ampere's Law, Gauss' Law in magnetism; Derive

		expression for magnetic force between two parallel conductors, Evaluate magnetic field along the axis of circular coil and solenoid. **CO4:** Explain electromagnetic induction, Faraday's law of induction, Lenz's law, self and mutual inductance; Evaluate energy stored in magnetic field, inductances in series and parallel combination. **CO5:** Acquire knowledge AC circuits, Kirchoff's laws for AC circuits, complex reactance and impedance, RC, RL, LC and LCR circuits (series and parallel). **CO6:** Evaluate electric and magnetic fields, potential, force and work using various laws; use Faradays laws in solving induction problems and learn the properties of basic circuit elements.	
7	**Course Description**	This course describes the various laws related to electricity and magnetism laying foundation for advance courses such as electromagnetic theory. The course also provides an understanding of electromagnetic induction to further describe the properties of electrical circuits.	
8	Outline Syllabus		CO Mapping
	Unit 1	**Electrostatics**	
	A	**Coulomb's Law:** Coulomb's Law of force, electrostatic field and intensity, electric flux.	CO1, CO6
	B	**Gauss Law:** Gauss law and calculation of electric field using Gauss Law	CO1, CO6
	C	**Potential**: Electric potential, equipotential surfaces, electrostatic energy and potential energy due to charge distribution	CO1, CO6
	Unit 2	**Capacitor**	
	A	**Types of capacitors:** Different types of capacitors: parallel plate capacitor, spherical, cylindrical and guard ring capacitor.	CO2, CO6
	B	**Energy stored:** energy stored in a capacitor, force of attraction between capacitor plate	CO2, CO6
	C	**Capacitors with dielectrics:** capacitance of partially and completely filled dielectric	CO2, CO6
	Unit 3	**Magnetic effect of current**	
	A	**Magnetic effect of current:** Magnetic effect of current, definition of **B,** magnetic force on a current carrying conductor, torque on a current loop in a uniform magnetic field.	CO3, CO6
	B	**Bio Savart's Law:** magnetic flux density, Bio-Savart's Law, Magnetic force between two parallel conductors, Ampere's Law.	CO3, CO6
	C	**Gauss Law in magnetism:** Gauss' Law in magnetism, Magnetic field along the axis of circular coil and solenoid.	CO3, CO6
	Unit 4	**Electromagnetic Induction**	
	A	**Electromagnetic induction:** Faraday's Law of induction, Lenz's Law, induced emf and electric field	CO4, CO6
	B	**Energy:** Energy stored in magnetic field.	CO4, CO6
	C	**Inductance:** Self Inductance, Mutual inductance, inductances in series and parallel.	CO4, CO6
	Unit 5	**Electrical Circuits**	
	A	**AC Circuits:** AC circuits, Kirchhoff's laws for AC circuits.	CO5, CO6
	B	**Reactance:** Complex reactance and Impedance.	CO5, CO6
	C	**Series and Parallel circuits:** RC, RL, LC and LCR circuits (series and parallel) excluding oscillations	CO5, CO6

	Mode of Examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text books	1. David J Griffiths, "Introduction to electrodynamics" Pearson New International Edition 2. Halliday, Resnick and Walker, "Fundamentals of Physics Electricity and Magnetism" John Wiley 3. Matthew N O Sadiku, "Principles of Electromagnetics" 4. John David Jackson, "Classical Electrodynamics" John Wiley and Sons, Inc. 5. Joseph Edminister, "Schaum's Outline of Electromagnetics"			
	Other References	1. S Mahajan and Chaudhary, "Electricity, Magnetism and electromagnetic theory" TMH 2. D N Vasudeva, "Fundamentals of Electricity and Magnetism" S Chand and Company 3. K K Tewari, "Electricity and Magnetism" S. Chand			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C219.1	2	2	2	2	2	2	1	1	2	1
C219.2	1	2	1	2	1	1	2	1	1	2
C219.3	2	1	2	1	2	2	1	2	2	1
C219.4	2	2	1	2	2	1	1	1	1	2
C219.5	1	2	2	2	2	2	2	1	2	1
C219.6	2	2	2	2	2	1	1	1	1	2

Statistics I (MSM 207)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: III**
1	Course Code.	MSM207
2	Course Title	STATISTICS I
3	Credits	4
4	Contact Hours	3-1-0

	(L-T-P)	
	Course status	Compulsory
5	Course Objectives	1. To introduce basic statistical concepts, logics and analytical tools, analyze and communicate quantitative data verbally, graphically, symbolically and numerically. 2. To make students familiar with the concept of Probability and Statistics and display data by means of various tables, charts, and graphs.
6	Course Outcomes	CO1: Describe the process and particular steps in designing studies, collecting and analyzing data, interpreting and presenting results; and develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries. (K2, K5) CO2: Describe the properties of discrete and continuous distribution functions. (K2) CO3: Calculate the measures of central tendency and dispersion of a data and describe the method used for analysis, including a discussion of advantages, disadvantages, and necessary assumptions. (K2, K3) CO4: Calculate and interpret the correlation between two variables and Calculate the simple linear regression equation for a set of data and know the basic assumptions behind regression analysis. (K2, K3) CO5: Understand the line of best fit as a tool for summarizing a linear relationship and predicting future observed values, develop the ability to use formal mathematical argument in the context of probability. (K2, K5) CO6: Develop the skills to interpret the results of statistical analysis. (K2, K5)
7	Course Description	This is an introductory course in statistics. Students are introduced to the fundamental concepts involved in using sample data to make inferences about populations. Included are the study of measures of central tendency and dispersion, finite probability, statistical inferences from large and small samples, linear regression, and correlation.
8	Outline syllabus:	
UNIT 1	**Presentation of data**	CO Mapping
A	Classification, tabulation, diagrammatic & graphical representation of grouped data.	CO1, CO6
B	Frequency distributions, cumulative frequency distributions	CO1, CO2, CO6
C	Histogram, Ogives, frequency polygon, Tree and leaf diagram.	CO1, CO6
UNIT 2	**Descriptive statistics**	

A	Measures of central tendency – arithmetic mean, median, quartiles, mode, harmonic mean, geometric mean.	CO1, CO3, CO6
B	Their properties, merits and demerits	CO1, CO3, CO6
C	Measures of dispersion – range, quartile deviation, mean deviation, standard deviation and coefficient of variation.	CO1, CO3, CO6
UNIT 3	**Moments**	
A	Moments, Skewness, Measures of skewness: Karl Pearson's coefficient of skewness.	CO1, CO3, CO6
B	Quartile coefficient of skewness, Measure of skewness based on moments.	CO1, CO3, CO6
C	Kurtosis, measure of Kurtosis.	CO1, CO3, CO6
UNIT 4	**Bi-variate data analysis**	
A	Bivariate data, principles of least squares, fitting of polynomial curves and fitting of curves reducible to polynomial form.	CO1, CO4, CO6
B	Correlation: Spearman's rank correlation, Partial and Multiple Correlation (only two independent variables case).	CO1, CO4, CO6
C	Regression lines.	CO1, CO4, CO5, CO6
UNIT 5	**Probability**	
A	Random experiment, sample space, events, definition of probability.	CO1, CO5, CO6
B	Mutually exclusive events, prob. Of compound events, conditional probability.	CO1, CO5, CO6
C	Baye's theorem.	CO1, CO5, CO6

	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		30%	20%	50%

	Text books	1. 1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics".
	Other references	4. Daniel,WayneW.,"Biostatistics": Basic concept and Methodology for Health Science. 5. Grewal,B.S, "Higher Engineering Mathematics".

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C207.1	3	3	2	2	2	3	2	1	1	1
C207.2	2	3	3	3	3	2	1	2	1	2
C207.3	2	3	2	2	2	2	1	2	2	2
C207.4	2	2	2	3	2	2	1	2	2	2
C207.5	3	2	2	3	2	1	2	1	2	2
C207.6	3	3	2	2	3	3	2	2	2	2

Introduction to MATLAB (MSM 229)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: III**
1	Course Code	MSM-229
2	**Course Title**	**Introduction to MATLAB**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	The goal of this course is to introduce the necessary mathematical concepts for MATLAB and cover the syntax and semantics of MATLAB including control structures, comments, variables, functions etc. Once the foundations of the language have been established students will explore different types of scientific programming problems including curve fitting, ODE solving etc.
6	Course Outcomes	CO1: Describe the fundamentals of MATLAB and use MATLAB for interactive computations. (K2, K3) CO2: Demonstrate with strings and matrices and their uses. (K2, K3) CO3: Illustrate basic flow controls (if-else, for, while). (K3) CO4: Create plots and export this for use in reports and presentations. (K3, K5) CO5: Develop program scripts and functions using the MATLAB development environment. (K4, K5) CO6: Write the program for evaluates linear system of equations,

		ordinary differential equations in MATLAB. (K5,K6)			
7	Course Description	The course will give the fundamental knowledge and practical abilities in MATLAB required to effectively utilize this tool in technical numerical computations and visualisation in other courses. Syntax and interactive computations, programming in MATLAB using scripts and functions, rudimentary algebra and analysis. One- and two-dimensional graphical presentations. Examples on engineering applications.			
8	Outline syllabus	**Introduction to MATLAB**			CO Mapping
	Unit 1	**Introduction**			
	A	Vector and matrix generation, Subscripting and the colon notation.			CO1
	B	Matrix and array operations and their manipulations,			CO1
	C	Introduction to some inbuilt functions.			CO1
	Unit 2	**Relational and Logical Operators**			
	A	Flow control using various statement and loops including If-End statement, If-Else –End statement			CO1, CO3
	B	Nested If-Else-End Statement,			CO3
	C	For – End and While-End loops with break commands.			CO3
	Unit 3	**m-files**			
	A	Scripts and functions			CO2,CO5
	B	concept of local and global variable			CO2,CO5
	C	few examples of in-built functions, editing, saving m-files.			CO2,CO5
	Unit 4	**Two dimensional Graphics**			
	A	Basic Plots, Change in axes and annotation in a figure			CO4
	B	multiple plots in a figure			CO4
	C	saving and printing figures			CO4
	Unit 5	**Applications of MATLAB**			
	A	Solving a linear system of equations,			CO5, CO6
	B	Curve fitting with polynomials using inbuilt function such as polyfit, solving equations in one variable,			CO5, CO6
	C	Solving ordinary differential equations using inbuilt functions			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book	An introduction to MATLAB : Amos Gilat			
	Other References	1. Applied Numerical Methods with Matlab for engineering and Scientists by stevenchapra,			

		Mcgraw Hill. 2. Getting started with Matlab: RudraPratap	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C229.1	3	3	2	2	2	3	2	2	1	1
C229.2	2	3	3	3	3	2	1	2	1	2
C229.3	2	3	2	2	2	2	2	1	2	2
C229.4	2	2	2	3	2	2	2	2	2	2
C229.5	3	2	2	3	2	2	2	3	2	2
C229.6	3	3	2	3	3	3	2	2	2	2

Community Connect (CCU 401)

SCHOOL: School of Basic Sciences and Research		TEACHING DEPARTMENT: Community Connect		ACADEMIC SESSION : 2021-22	FOR STUDENTS BATCH – B. Sc and M. Sc.(2020-23 & 2020-22)
1	Course Number	Course Code: CCU401/ Course ID: 30804			
2	Course Title	Community Connect			
3	Credits	2			
3.01	(L-T-P)	(00-00-02)			
4	**Learning Hours**		Contact Hours	30	
			Project/Field Work	20	
			Assessment	00	
			Guided Study	10	
			Total hours	60	
5	**Course Objectives**	1. To expose our students to different social issues faced by the people in different sections of society. 2. To connect their class-room learning with problem solving skills in real life scenario.			
6	**Course Outcomes**	After completion of this course students will be able to: 1. Recognise social problems prevailing in different sections of society and finding the solution in sustainable manner. 2. Get practical exposure of all round development which complements their class room learning			

		3. These activities will add value to students, faculty members, school and university.
7	**Theme**	**Major themes for research:** 1. ***Survey and self-learning***: In this mode, students will make survey, analyze data and will extract results out of it to correlate with their theoretical knowledge. E.g. Crops and animals, land holding, labour problems, medical problems of animals and humans, savage and sanitation situation, waste management etc. 2. ***Survey and solution providing***: In this mode, students will identify the common problems and will provide solution/ educate rural population. E.g. air and water pollution, need of after treatment, use of renewable (mainly solar) energy, electricity saving devices, inefficiencies in cropping system, animal husbandry, poultry, pest control, irrigation, machining in agriculture etc. 3. ***Survey and reporting***: In this mode students will educate villagers and survey the ground level status of various government schemes meant for rural development. The analyzed results will be reported to concerned agencies which will help them for taking necessary/corrective measures. E.g. Pradhan Mantri Jan Dhan Yojana, Pradhan Mantri MUDRA Yojana, Pradhan Mantri Jeevan Jyoti Bima Yojana, Atal pension Yojana, Pradhan Mantri Awas Yojana, Pradhan Mantri FasalBima Yojana, Swachh Bharat Abhiyan, Soil Health Card Scheme, Digital India, Skill India Program,BetiBachao, BetiPadhao Yojana, DeenDayal Upadhyaya Gram Jyoti Yojana, Shyama Prasad Mukherjee Rurban Mission, UJWAL Discom Assurance Yojana, PAHAL,Pradhan Mantri Awas Yojana-Gramin, Pradhan Mantri Yuva Yojana, Pradhan Mantri Jan Aushadhi Yojana, Pradhan Mantri KhanijKshetra Kalyan Yojana, Pradhan Mantri Suraksha Bima Yojana, UDAN scheme, DeenDayal Upadhyaya Grameen Kaushalya Yojana, Pradhan Mantri Sukanya Samriddhi Yojana, Sansad Adarsh Gram Yojana, Pradhan Mantri SurakshitMatritva Abhiyan, Pradhan Mantri RojgarProtsahan Yojana, Midday Meal Scheme, Pradhan Mantri Vaya Vandana Yojana, Pradhan Mantri Matritva Vandana Yojana, and Ayushman Bharat Yojana.
8.1	**<u>Guidelines for Faculty Members</u>**	It will be a group assignment. There should be not more than 10 students in each group. The faculty guide will guide the students and approve the project title and help the student in preparing the questionnaire and final report. The questionnaire should be well design and it should carry at least 20 questions (Including demographic questions). The faculty will guide the student to prepare the PPT. The topic of the research should be related to social, economical or environmental issues concerning the common man. The report should contain 2,500 to 3,000 words and relevant charts, tables and photographs. The student should**submit the report**to CCC-Coordinator signed by the faculty guide by 15 April 2019.

		The students have to send the hard copy of the **report and PPT**, and then only they will be allowed for ETE.
8.2	**Role of CCC-Coordinator**	The CCC Coordinator will supervise the whole process and assign students to faculty members. 1. PG-M.Sc.-Semester II – the students will be allocated to faculty member (mentors/faculty member) in even term. **2.** UG- B.Sc.(H).-Semester III - the students will be allocated to faculty member (mentors/faculty member) in odd term.
8.3	**Layout of the Report**	Abstract(250 words) a. Introduction b. Literature review(optional) c. Objective of the research d. Research Methodology e. Finding and discussion f. Conclusion and recommendation g. References Note: Research report should base on primary data.
8.4	**Guideline for Report Writing**	**Title Page: The following elements must be included:** • Title of the article; • Name(s) and initial(s) of author(s), preferably with first names spelled out; • Affiliation(s) of author(s); • Name of the faculty guide and Co-guide **Abstract:** Each article is to be preceded by a succinct abstract, of up to 250 words, that highlights the objectives, methods, results, and conclusions of the paper. **Text:Manuscripts should be submitted in Word.** • Use a normal, plain font (e.g., 12-point Times Roman) for text. • Use italics for emphasis. • *Use the automatic page numbering function to number the pages.* • *Save your file in docx format* (Word 2007 or higher) or doc format (older Word versions) **Reference list:** The list of references should only include works that are cited in the text and that have been published or accepted for publication. The entries in the list should be in alphabetical order. Journal article Hamburger, C.: Quasimonotonicity, regularity and duality for nonlinear systems of partial differential equations. Ann. Mat. Pura Appl. 169, 321–354 (1995) Article by DOI Sajti, C.L., Georgio, S., Khodorkovsky, V., Marine, W.: New nanohybrid materials for biophotonics. Appl. Phys. A (2007). doi:10.1007/s00339-007-4137-z Book Geddes, K.O., Czapor, S.R., Labahn, G.: Algorithms for Computer Algebra. Kluwer, Boston (1992) Book chapter Broy, M.: Software engineering — from auxiliary to key technologies. In: Broy, M.,

		Denert, E. (eds.) Software Pioneers, pp. 10–13. Springer, Heidelberg (2002) Online document Cartwright, J.: Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1 (2007). Accessed 26 June 2007 Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see www.issn.org/2-22661-LTWA-online.php For authors using EndNote, Springer provides an output style that supports the formatting of in-text citations and reference list. EndNote style (zip, 2 kB) **Tables:All tables are to be numbered using Arabic numerals.** **Figure Numbering:All figures are to be numbered using Arabic numerals**. The soft copy of final report should be submitted by email to Dr. Piali Haldar(piali.haldar@sharda.ac.in)within 16th **April2019 along with hard copy signed by faculty guide.**
8.5	**Format:**	**The report should be Spiral/ hardbound** The Design of the Cover page to report will be given by the Coordinator- CCC Coverpage Acknowledgement Content Project report Appendices

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C401.1	-	-	1	1	1	-	2	1	-	2
C401.2	-	-	2	1	1	-	2	2	-	2
C401.3	-	-	1	1	2	-	2	1	-	2

Ordinary Differential Equations (MSM 214)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: IV**
1	Course Code	MSM 214
2	Course Title	ORDINARY DIFFERENTIAL EQUATION
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0

	Course Status	Compulsory	
5	Course Objective	To Familiarise students with basic concepts of ordinary differential equations. Learn to solve first-order differential equations. Explore the methods to solve Linear differential equation of nth order with constant coefficients. Application of variation of parameters method to solve ordinary differential equations. Explore the use of series methods to solve problems with variable coefficients.	
6	Course Outcomes	CO1: Explain the classification of ordinary differential equations according to order and linearity. (K2, K4) CO2: Demonstrate several methods like variable separable, homogeneous, exact etc. to solve linear first-order differential equations. (K2, K3) CO3: Solve second order and higher order linear differential equations. (K3) CO4: Describe the solution of Cauchy Euler's equations and solve Simultaneous linear differential equations. (K2, K3) CO5: Discuss working rule for finding complete solution and method of variation of parameters to evaluate linear differential equation. (K3, K6) CO6: Discuss series solution of ordinary differential equations and evaluate 2nd order differential equation with variable coefficients. (K2, K6)	
7	Course Description	This course covers basic concepts of ordinary differential equations. Learn to solve first-order differential equations. Explore the methods to solve Linear differential equation of nth order with constant coefficients. Application of variation of parameters method to solve ordinary differential equations. Explore the use of series methods to solve problems with variable coefficients.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Basics of differential equations including order, degree, type of differential equation and formation of differential equations.	CO1
	B	Equations of first order and first degree including separation of variables, homogeneous and exact differential equations (including integrating factor).	CO2
	C	Linear differential equations.	CO2
	Unit 2		
	A	Linear differential equation of nth order with constant coefficients	CO1, CO3
	B	Auxiliary equations and complementary functions	CO3
	C	Particular integrals for various standard functions and their combinations.	CO3
	Unit 3		
	A	Homogeneous linear equations or Cauchy Euler's equations	CO4
	B	Equations reducible to homogeneous form	CO4
	C	Simultaneous linear differential equations.	CO4

	Unit 4				
	A	Linear equations of second order			CO3, CO5
	B	working rule for finding complete solution when an integral of C.F. is known			CO5
	C	removal of first order derivative, method of variation of parameters.			CO5
	Unit 5				
	A	Series solution of ordinary differential equations of 2nd order with variable coefficients			CO6
	B	various cases e.g., ordinary point, regular singular point			CO6
	C	Irregular singular points.			CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Ordinary and Partial Differential equations by M. D. Raisinghania, S Chand and Company Ltd. 2. Schaum's Outline series of Differential equations by Richard Bronson, Gabriel Costa.			
	Other References	1. An introduction to Ordinary Differential Equations by Earl. A. Codington, DOVER PUBLICATIONS, INC. New York.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C214.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C214.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C214.3	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**
C214.4	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C214.5	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**3**
C214.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

Real Analysis I (MSM 208)

School: SBSR	**Batch : 2020- 2023**
Program: B.Sc.(H)	**Academic Year: 2021-22**

Branch: Mathematics		Semester: IV	
1	Course Code	MSM 208	
2	**Course Title**	**Real Analysis-I**	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	To make students familiar with the basic concepts of real analysis. The notion of limit, continuity, differentiability, sequences, infinite series & their convergence has been also introduced.	
6	Course Outcomes	CO1: Discuss the basic concepts of set theory on R, open & closed sets, bounded & unbounded sets, countable & uncountable sets and calculate the limit points of sets. (K2, K3) CO2: Describe the concept of Limit, Continuity, and Continuous & Discontinuous functions, Uniform continuous functions and calculate same. (K2, K3) CO3: Define the definition of derivatives, increasing & decreasing functions, explain Darboux's theorem, Rolle's theorem, Men Value Theorem & its applications. (K1, K4) CO4: Calculate and analyze the convergent sequences, limit point of sequence, non-convergent sequence, and monotonic sequences. (K3,K4) CO5: Explain the concept of series and illustrate the test for series.(K2, K3, K4) CO6: Evaluate Positive terms series, Alternating series, Series with arbitrary terms. (K6)	
7	Course Description	This is an introductory course of real analysis. Students are introduced to the fundamental concepts of real analysis. The notion of limit, continuity, differentiability, sequences, infinite series & their convergence has been also introduced	
8	Outline syllabus : **Real Analysis -1**		CO Mapping
	Unit 1	**ELEMENTS OF POINTS SET THEORY ON R**	
	A	Sets, Intervals: Open and closed, Bounded and unbounded sets, Supremum and infimum	CO1

	B	Neighborhood of a point, Open and Closed sets, Limits points of a set, Bolzano – Weierstrass Theorem (statement)	CO1
	C	Countable and Uncountable sets	CO1
	Unit 2	**LIMIT & CONTINUITY OF FUNCTIONS ON R**	
	A	Limit of a function, Theorems on algebra of limits, Limit or a function	CO2
	B	Sequential approach, Cauchy's criteria for finite limits	CO2
	C	Continuous functions, Discontinuous functions, Properties of continuous functions on closed intervals, Uniform continuous functions and related results	CO2
	Unit 3	**DIFFERENTIATION OF FUNCTIONS ON R**	
	A	Definitions of derivatives and related results, increasing and decreasing functions	CO3
	B	Darboux's theorem, Rolle's Theorem,	CO3
	C	Mean value theorems of differential calculus and their applications	CO3
	Unit 4	**SEQUENCES**	
	A	Sequences, Bounded and convergent sequences	CO4
	B	Limit Points of a sequence, Bolzano – Weierstrass Theorem, Limit inferior and superior,	CO4
	C	Non-convergent (divergent) sequence, Cauchy's general principle of convergence, monotonic sequences.	CO4
	Unit 5	**INFINTE SERIES & THEIR CONVERGENCE**	
	A	Series of positive terms: p- test, the comparison, Cauchy's root and D' Alembert ratio tests (without proof), Logarithmic and Integral test	CO5, CO6
	B	Alternating series, Leibnitz test, absolute and conditional convergence	CO5, CO6
	C	Series of arbitrary terms, Abel's and Dirichlet's tests.	CO5, CO6

	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. S.C. Malik and SavitaArora: Mathematical Analysis, Second Edition, Wiley EasternLimited, New Age International Limited, New Delhi, 1994.			
	Other References	2.D. Somasundram and B. Chaudhary: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987. 3.Rudin, Walter, Principles of Mathematical Analysis, third edition, InternationalSeries in Pure and Applied Mathematics. McGraw-Hill Book Co., New York-Auckland-D usseldorf, 1976. 4.T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C208.1	3	3	2	2	2	3	2	2	2	1
C208.2	2	3	3	3	3	2	1	2	1	2
C208.3	2	3	2	2	2	2	2	1	2	2
C208.4	2	2	2	3	2	2	1	2	2	2
C208.5	1	1	2	2	2	1	2	2	2	3
C208.6	3	2	3	1	2	2	2	1	2	1

Numerical Analysis (MSM 213)

School: SBSR	**Batch : 2020- 2023**
Program: B.Sc.(H)	**Academic Year: 2021-22**
Branch: Mathematics	**Semester: IV**

1	Course Code	MSM 213	
2	**Course Title**	**Numerical Analysis**	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	1. To provide the student with numerical methods of solving the non-linear equations, interpolation, differentiation, and integration. 2.To improve the student's skills in numerical methods by using the MATLAB	
6	Course Outcomes	CO1:Solve a linear system of equations using an appropriation method and develop the algorithm in MATLAB. (K1,K3,K5,K6) CO2: Solve the algebraic or transcendental equations using numerical methods and develop the algorithm in MATLAB. (K1,K3,K5,K6) CO3: Discuss the finite difference methods to analyse the functions (K2,K4) CO4: Explain the divided difference and evaluate the function. (K2, K4, K5) CO5:Describe the numerical differentiation and evaluate the differentiation. (K1, K2, K5) CO6: Calculate a definite integral using an appropriation method and develop the algorithm in MATLAB. (K1,K3,K5,K6)	
7	Course Description	This course is an introduction to the numerical analysis. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems in MATLAB.	
8	Outline syllabus		CO Mapping
	Unit 1	**Solution of system of linear equations:**	
	A	Direct methods: Cramer's rule, Matrix inverse method	CO1
	B	Gauss elimination and Gauss-Jordan method	CO1
	C	Iterative methods: Jacobi's method, Gauss-Seidal method	CO1
	Unit 2	**System of Transcendental equations**	
	A	Initial approximation of the roots, Bisection method, Method of false position	CO2
	B	secant method, iteration method,	CO2
	C	Newton-Raphson method and its convergence	CO2
	Unit 3	**Finite differences and interpolation**	
	A	Finite difference operators, their properties and their interrelations, finite difference tables	CO3
	B	Newton's forward and Newton's backward interpolation formula	CO3
	C	Central difference formulae including Stirling's formula, Bessel's formula	CO3
	Unit 4	**Divided differences**	
	A	Operators and difference table	CO4

	B	Newton's divided difference formula,			CO4
	C	Lagrange's interpolation formula.			CO4
	Unit 5	**Numerical differentiation and integration**			
	A	Differentiation using Newton's forward and backward formula			CO5
	B	Newton-Cotes Quadrature formula - derivations & comparison of Trapezoidal rule			CO6
	C	Simpson's 1/3 and 3/8 rules.			CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1) An Introduction to Numerical Analysis by EndreSuli, David F. Mayers, Cambridge University Press, 2003. 2) Applied Numerical Analysis by C. F. Gerald, Pearson Education, 2009. 3) Elements of Numerical Analysis by R. S. Gupta, Macmillan India Ltd, 2009.			
	Other References	1) Numerical methods in Engineering & Science by B. S. Grewal, Khanna Publishers, 2013. 2) Numerical methods for Scientific and Engineering Computation by Jain, Iyengar, Jain, New Age International Publishers, 2004.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C213.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**1**
C213.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**
C213.3	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
C213.4	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**1**
C213.5	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**
C213.6	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**

Statistics II (MSM 211)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: IV**
1	Course Code.	MSM 211
2	Course Title	STATISTICS II
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course status	Compulsory
5	Course Objectives	To make students familiar with the concept of probabilities of joint events such as unions and intersections from the probabilities of individual events. Determine the independence of events and use independence to calculate probabilities. Use Bayes' theorem to calculate conditional probabilities. Understand random variables and its distributions. Have Some special probability distributions -The Normal distribution. Motivate the use of statistical inference in practical data analysis. Understand hypothesis testing as making an argument.
6	Course Outcomes	CO1: Explain the basic concepts of probability, random variables, probability distribution, and joint probability distribution. Apply selected probability distributions to solve problems. (K2, K3, K4) CO2: Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions. (K2, K3, K5) CO3: Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables. (K3, K5) CO4: Calculate the Expected value of the random variable. Use of normal distributions for computing relevant probabilities and area under standard normal probability curve. (K2, K3) CO5: Estimate and evaluate population parameters from the statistics of samples. (K2, K6) CO6: Assess statistical hypothesis using large and small samples. (K3, K6)
7	Course Description	This course covers the role of statistics in probability, discrete random variables and probability distributions, continuous random variables and probability distributions, joint probability distributions, random sampling and data description, point estimation of parameters, statistical intervals for a sample, and tests of hypotheses for large and small samples.

8	Outline syllabus: Statistics II		CO Mapping
	UNIT 1	**Probability**	
	A	Definition of probability, Bayes theorem and its applications.	CO1

	B	Random variables – discrete and continuous, probability mass function (pmf) and probability density function (pdf).				CO2, CO3
	C	Expectation of a random variable (rv) and its variance in discrete and continuous cases; Moment generating function (MGF).				CO3, CO4
	UNIT 2	**Probability Distributions**				
	A	Discrete distributions: Binomial distribution and Poisson distribution, Geometric distribution.				CO2, CO3
	B	Their mean and varianc , MGF.				CO2, CO3
	C	Continuous distributions: Exponential distribution, Gamma distribution, Weibull distribution.				CO2, CO3
	UNIT 3	**Normal distribution**				
	A	Normal distribution: Mean and variance, transformation to standard normal distribution, use of tables of standard normal prob. Distribution.				CO4
	B	Approximation of binomial probabilities using standard normal distribution.				CO4
	C	Sampling distributions: Distribution of sample proportions and sample means. (Large samples) Use of normal distribution for estimating population proportion and population mean using the corresponding sample statistics.				CO5
	UNIT 4	**Sampling distributions**				
	A	Sampling distribution of difference of two sample means.				CO5
	B	Sampling distribution of difference of two sample proportions.				CO5
	C	Estimations and hypothesis testing for single sample and two sample cases.				CO5, CO6
	UNIT 5	**Hypothesis testing for small sample**				
	A	Applications of t-distribution.				CO5, CO6
	B	Chi-square test for goodness of fit.				CO5, CO6
	C	Applications of F- distribution.				CO5, CO6
	Mode of Examination	Theory				Mode of Examination
	Weightage	CA	MTE	ETE		Weightage

	distribution				distribution
		30%	20%	50%	
	Text books	2. 1. Gupta, S.C and Kapoor, V.K, "Fundamental of Mathematical Statistics".			Text books
	Other references	6. Daniel, Wayne W.,"Biostatistics": Basic concept and Methodology for Health Science. 7. Grewal, B.S, "Higher Engineering Mathematics".			Other references

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C211.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C211.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C211.3	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**
C211.4	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**
C211.5	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**
C211.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

MATHEMATICAL LOGIC BUILDING- I(MSM 212)

School: SBSR		**Batch : 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2021-22**
Branch: Mathematics		**Semester: IV**
1	Course Code	MSM 212
2	**Course Title**	**MATHEMATICAL LOGIC BUILDING- I**
3	Credits	2
4	Contact Hours (L-T-P)	2-0-0
	Course Status	Compulsory
5	Course Objective	To make students familiar with the logical mathematics. The concept of speed mathematics, type of equations, permutation and

		combination, coding/decoding and allegation & mixture, inequalities.	
6	Course Outcomes	CO1: Explain and illustrate the conceptsspeed maths, number system, LCM/HCF, unit digits & divisibility. (K2, K3, K4) CO2: Describe the properties of Quadratic Equations, Linear Equations and Logarithms and evaluate. (K1, K2, K3, K5) CO3: Describepermutation and combination;explain Probability, Chain Rule, Surds & Indices, and Square roots & Cube roots. (K2, K3, K4) CO4: Describe percentage; ratio & proportions explain its application and profit & loss. (K2, K3, K4) CO5: Describe the Coding/Decoding, Number Ranking, Blood Relations and evaluate partnerships, series completions, and puzzles. (K2, K3, K6) CO6: Describe and analyze the basic concepts of seating arrangements, directions, syllogism, analogies, allegation & mixture, inequalities and it's application. (K1,K2, K4)	
7	Course Description	This course is developing logical mathematics concept. The primary objective of the course is to develop the basic understanding of the concept of speed mathematics, type of equations, permutation and combination, coding/decoding and allegation &mixture, inequalities.	
8	Outline syllabus :		CO Mapping
	Unit 1		
	A	Speed Maths, Number System,	CO1
	B	LCM/HCF, Unit Digits & divisibility	CO1
	C	Quadratic Equations, Linear Equations and Logarithms.	CO2
	Unit 2		
	A	Permutation and Combination,	CO3
	B	Probability, Chain Rule, Surds & Indices,	CO3
	C	Square roots & Cube roots.	CO3
	Unit 3		
	A	Percentage,	CO4
	B	Ratio & Proportions,	CO4

	C	Profit & Loss.			CO4
	Unit 4				
	A	Coding/Decoding, Number Ranking,			CO5
	B	Blood Relations, Partnerships,			CO5
	C	Series Completions, Puzzles.			CO5
	Unit 5				
	A	Seating Arrangements, Directions,			CO6
	B	Syllogism, Analogies,			CO6
	C	Allegation & Mixture, Inequalities.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Dr. R.S. Aggarwal, Quantitative aptitude, S. Chand Publication.			
	Other References	1. P.A. Anand, Quantitative aptitude, Wiley publication. 2. Dr. R.S. Aggarwal, A modern approach to verbal & non- verbal reasoning, S. Chand Publication. 3. R. V. Praveen, Quantitative aptitude & reasoning, PHI Publication.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C212.1	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**1**
C212.2	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**
C212.3	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**2**
C212.4	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**
C212.5	**3**	**2**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**1**

C212.6	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**

Analytical Geometry (MSM 216)

School: SBSR		**Batch : 2020- 2023**	
Program: B. Sc. (H)		**Academic Year: 2021-22**	
Branch: Mathematics		**Semester: IV**	
1	Course Code	MSM 216	
2	Course Title	Analytical Geometry	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	To make students familiar with the concepts of vectors(Three dimensional vectors), Planes(Equation of planes), Lines, Spheres, Cones, Cylinders and Quadric surfaces .	
6	Course Outcomes	CO1: Describe two dimensional and three dimensional vectors and calculate direction cosines, dot and cross products, triple products of vectors. (K1, K3) CO2: Discuss equation of planes, calculate distance and angle between two planes and explain about planes through three given non-collinear points and it's geometrical applications. (K2, K3, K4) CO3: Explain the equation of a straight line in different forms and calculate the magnitude of the shortest distance between two skew line and formulate the equation. (K2,K3, K4, K5) CO4: Discuss the equations of Sphere, Cylinder, Cone and evaluate tangent plane and normal at a point of the sphere, Orthogonal spheres. (K2, K6) CO5: Describe ellipsoid, hyperboloid of one sheet and two sheets. (K1, K2) CO6: Discuss and evaluate surface of revolution, ellipsoid of revolution, paraboloid of revolution. (K2, K6)	
7	Course Description	This course is an introduces three dimensional vectors, planes, Lines, Spheres, Cones, Cylinders and Quadric surfaces .	
8	Outline syllabus		CO Mapping
	Unit 1	**Vectors**	
	A	Two dimensional vectors, addition and subtraction,Scalar multiplication, simple applications of vectors in plane Geometry.	CO1
	B	Three dimensional vectors: direction cosines, resolution of vectors, section formula, dot and cross products, tripleproducts.	CO1
	C	Geometrical and physical applications	CO1

	Unit 2	**Planes**			
	A	Equation of a plane, normal to a plane, Distance from a point to a plane, parallel planes.			CO2
	B	Planes through the intersection of two planes, Planes bisecting the angle between two planes			CO2
	C	Planes through three given non-collinear points, geometrical applications.			CO2
	Unit 3	**Lines**			
	A	Equation of a straight line in different forms; Condition for a line to lie on a plane; Condition for two lines to intersect			CO3
	B	Skew lines			CO3
	C	Equation and magnitude of the shortest distance between two skew lines.			CO3
	Unit 4	**Sphere, Cone, Cylinder**			
	A	Equation of a sphere, Tangent plane and normal at a point of the sphere, Orthogonal spheres			CO4
	B	Equation of a cone with guiding curve a circle, ellipse.			CO4
	C	Equation of a right circular cylinder.			CO4
	Unit 5	**Quadric surfaces**			
	A	Ellipsoid, hyperboloid of one sheet and two sheets.			CO5, CO6
	B	Elliptic paraboloid.			CO5, CO6
	C	Surface of revolution, ellipsoid of revolution, paraboloid of revolution.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**1.** Thomas, B.G., and Finny R.L.: Calculus and Analytical geometry", Pearson education Asia, AdisonWisley.			
	Other References	1. Jonathan B. Cabero, et al :Analytic Geometry, National Book Store, Inc. 2. *B*. S. Grewal: Higher Engg. Mathematics, Khanna Publishers.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO										

C216.1	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**1**
C216.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**1**
C216.3	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**2**
C216.4	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C216.5	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
C216.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

Real Analysis II (MSM 302)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H)		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: V**
1	Course Code	MSM 302
2	**Course Title**	**Real Analysis-II**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	To make students familiar with the basic concepts of Real analysis. The notion & properties of Riemann integration, sequences & series of a function and Improper Integrals has been also introduced.
6	Course Outcomes	CO1: Discuss the basics of Real analysis included Mean value theorem, Taylor's &Maclaurin's Series, define the convergence & divergence of a series and calculate lim sup &liminf of divergent sequences. (K1, K2, K3) CO2: Discuss about the notion of Riemann Integration, solve Reimann sum & Riemann integrability of continuous functions, monotonic functions, and functions with finitely many discontinuities. (K1, K3) CO3: Calculate differentiation and Riemann integration, illustrate Fundamental theorem of Calculus, Evaluation of some limits of series using Riemann integration method. (K3, K4)

		CO4: Calculate point-wise convergence of series of functions, uniform convergence and evaluate term by term integration of infinite series, term by term differentiation. (K3,K6) CO5: Evaluate different types of improper integrals, convergence of improper integrals; apply tests for convergence. (K4,K5) CO6: Explain Gamma and Beta functions and evaluate some standard integrals. (K2, K4, K5)	
7	Course Description	This course is an introduce the basic concepts of Real analysis. The notion & properties of Riemann integration, sequences & series of a function and Improper Integrals has been also introduced.	
8	Outline syllabus :**Real Analysis -II**		CO Mapping
	Unit 1	**REVIEW OF REAL ANALYSIS-1**	
	A	Mean value theorems, Taylor and Maclaurin series expansions	CO1
	B	Convergence and divergence of series (convergence theorems, types of convergence)	CO1
	C	lim sup and liminf of divergent sequences	CO1
	Unit 2	**RIEMANN INTEGRATION**	
	A	Riemann Integration: motivation for the definition of the integral, bounded functions	CO2
	B	Partition of [a, b], Riemann sums, definition of Riemann integration, Preliminary theorems	CO2
	C	The Riemann integrability of (i) continuous functions (ii) monotonic functions (iii) functions with finitely many discontinuities.	CO2
	Unit 3	**PROPERTIES OF RIEMANN INTEGRATION**	
	A	Differentiation and Riemann integration, Integration by parts, Fundamental theorem of Calculus,	CO3
	B	Practical evaluation of integrals of some simple functions using definition of Riemann integration	CO3
	C	Evaluation of some limits of series using Riemann integration method.	CO3

	Unit 4	**SEQUENCES & SERIES OF FUNCTIONS**			
	A	Point-wise convergence of series of functions, Uniform convergence,			CO4
	B	Cauchy's criterion for uniform convergence, Weirstrass M-test, uniform convergence			CO4
	C	Term by term integration of infinite series, term by term differentiation.			CO4
	Unit 5	**IMPROPER INTEGRALS**			
	A	Different types of improper integrals, convergence of improper integrals at lower and upper limits of integration and convergence at intermediate points			CO5, CO6
	B	Tests for convergence, treatments of different types of improper integrals			CO5, CO6
	C	The Gamma and Beta functions, some standard integrals, different problems.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1.Walter Rudin: Principles of Mathematical Analysis, McGraw Hill Education(India) Private Limited, New Delhi , Edition 2013.			
	Other References	2.S.C. Malik and SavitaArora: Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delhi, 1994.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C302.1	**3**	**3**	**2**	**2**	**2**	**3**	**1**	**2**	**1**	**2**
C302.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**

C302.3	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
C302.4	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**
C302.5	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**1**
C302.6	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**

Operations Research (MSM 315)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2022-23**
Branch: Mathematics		**Semester: V**
1	Course Code	MSM-315
2	**Course Title**	**Operations Research**
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To provide the students are able to formulate a real-world problem as a mathematical programming model, understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand, relationship between a linear program and its dual, including strong duality and complementary slackness and solve specialized linear programming problems like the transportation and assignment problems.
6	Course Outcomes	CO1: Identify and develop operational research models from the verbal description of the real system. (K1, K5) CO2: Understand and apply the mathematical tools that are needed to solve optimisation problems. (K2, K3) CO3: Understand the applications of basic methods for solving L.P.P. and challenges in Linear programming. (K2, K3). CO4: Discuss transportation problem and assignment problem, Decision Theory, formulate and solve T.P, A.P. (K2, K3, K6) CO5: Describe the characteristics of Game Theory and solve two person zero sum game. (K1,K2, K3) CO6: Explain game theory and formulate and solve real system problem of game theory. (K2, K3, K4, K6)
7	Course Description	Operations research (OR) have many applications in science, engineering, economics, and industry and thus the ability to solve OR problems are crucial for both researchers and practitioners. Being able to solve the real life problems and obtaining the right solution requires understanding and modelling the problem correctly and applying appropriate optimization tools and skills to solve the mathematical model. The goal of this course is to teach students to formulate, analyze, and solve mathematical models that represent

		real-world problems.. In particular, we will cover linear programming.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Origin of OR, Historical Standpoint, Different Phases, characteristics, Scope and application of OR	CO1, CO2
	B	General linear programming Problem, Formulation of Linear programming problem.	CO1, CO2
	C	Existence of basic feasible solution and optimal solution of simple LPPs (few examples), graphical interpretation of optimality.	CO1, CO2
	Unit 2		
	A	Solution of a LPP by Simplex algorithm	CO1, CO3
	B	Big- M method.	CO1, CO3
	C	Degeneracy and its consequences including cases of cycling.	CO1, CO3
	Unit 3		
	A	Introduction to duality and formulation of dual LPP for different models through examples.	CO2, CO3
	B	Duality theorems and their illustrations.	CO2, CO3
	C	Dual simplex method.	CO2, CO3
	Unit 4		
	A	Special LPPs: Transportation programming problem.	CO2, CO4
	B	Assignment problems.	CO2, CO4
	C	Decision Theory	CO2, CO4
	Unit 5		
	A	Game Theory: Introduction, Characteristics of Game Theory, Two person zero sum game.	CO5, CO6
	B	Dominance method, mixed strategies	CO5, CO6
	C	Algebraic and graphical methods	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE 30% / 20% / 50%	
	Text book	**1.** Operation Research: Theory And Applications J K Sharma	
	Other References	1. Operations Research: An Introduction, 10th Edition Hamdy A. Taha, 2. Operations Research:KantiSwarup, P. K. Gupta, Man Mohan3. Operations Research: P Rama Murthyz.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C315.1	3	3	2	2	2	3	2	2	1	1
C315.2	2	3	3	3	3	2	2	2	1	2
C315.3	2	3	2	2	2	2	1	1	2	2
C315.4	2	2	2	3	2	2	2	2	2	2
C315.5	2	2	1	2	2	3	2	2	1	1
C315.6	3	2	2	2	3	2	3	2	2	2

Abstract Algebra (MSM 307)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2022-23**
Branch: Mathematics		**Semester: V**
1	Course Code	MSM 307
2	**Course Title**	ABSTRACT ALGEBRA
3	Credits	4
4	Contact Hours (L-T-P)	3-1- 0
	Course Code	Compulsory
5	Course Objective	To familiarise students with basic concepts of group, subgroup, cyclic group and permutation groups. The basic idea of cosets, normal subgroups, normalizer, centre, stabilizer and orbit. Concepts of homomorphism, isomorphism, automorphism and inner automorphism. The different algebraic structures ring, integral domain, field, ideal and quotient ring, prime and maximal ideal. The principal ideal domain, polynomial ring, division algorithm, Euclidean rings.
6	Course Outcomes	CO1: Describe the concept of group, subgroup, cyclic group and permutation groups. (K2) CO2: Explain the concept of cosets, normal subgroups, normalizer, centre, stabilizer and orbit. (K2, K4) CO3: Recognize and decide homomorphism group, isomorphic groups, automorphism and inner automorphism. (K1, K6) CO4: Define and discriminate Ring integral domain, field ideal and quotient ring, prime and maximal ideal. (K1, K6)

		CO5: Discuss about Principal ideal domainand evaluate polynomial ring. (K1,K2,K5) CO6:Explain Euclidean rings and develop division algorithm. (K2,K4, K6)	
7	Course Description	This course will cover basic concepts of group, subgroup, cyclic group and permutation groups. The basic idea of cosets, normal subgroups, normalizer, centre, stabilizer and orbit. Concepts of homomorphism, isomorphism, automorphism and inner automorphism. The different algebraic structures ring, integral domain, field, ideal and quotient ring, prime and maximal ideal. The principal ideal domain, polynomial ring, division algorithm, Euclidean rings.	
8	Outline syllabus		CO Mapping
	Unit 1	**Group theory-1**	
	A	Binary operations, Groups, subgroups	CO1
	B	Order of a group, cyclic group	CO1
	C	Group of permutations, cycles and alternating group.	CO1
	Unit 2	**Group theory-2**	
	A	Cosets, Normal subgroup, Normalizer	CO2
	B	Centre, stabilizer and orbits of groups	CO2
	C	Statement of Lagrange's theorem.	CO2
	Unit 3	**Group theory-3**	
	A	Homomorphism of groups, kernel of homomorphism	CO3
	B	Definition of isomorphism, automorphism,	CO3
	C	Inner automorphism, Factor group.	CO3
	Unit 4	**Ring Theory -1**	
	A	Rings, Integral Domains and Fields	CO4
	B	Ideal and quotient Rings	CO4
	C	Prime and maximal ideals	CO4
	Unit 5	**Ring Theory -2**	
	A	Principal ideal domains	CO5
	B	Polynomial Rings, Division algorithm	CO5, CO6
	C	Euclidean Rings, The ring Z[i]	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE	
		30% / 20% / 50%	
	Text book	An introduction to MATLAB : Amos Gilat	
	Other References	1. Applied Numerical Methods with Matlab for engineering and Scientists by stevenchapra, Mcgraw Hill. 2. Getting started with Matlab: RudraPratap	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C307.1	3	3	2	2	2	3	2	2	1	2
C307.2	2	3	3	3	3	2	1	2	1	2
C307.3	2	3	2	2	2	2	2	1	2	2
C307.4	2	2	2	3	2	2	2	2	2	2
C307.5	3	2	2	3	2	2	2	2	2	2
C307.6	2	2	3	2	2	2	3	2	1	1

Partial differential Equations (MSM 311)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2022-23**
Branch: Mathematics		**Semester: V**
1	Course Code	MSM 311
2	Course Title	PARTIAL DIFFERENTIAL EQUATIONS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	Familiarise students with basic concepts of partial differential equations and introduce students to how to solve linear Partial Differential with different methods. Learn to solve first-order partial differential equations and formation of PDEs. Explore the methods to solve Linear homogeneous and non-homogeneous PDEs with constant coefficients. Students will also master the technique of separation of variables to solve PDEs and able to derive heat and wave equations.
6	Course Outcomes	CO1: Formulate the partial differential equations and to solve linear PDEs by using Lagrange's method. (K3, K5) CO2: Explain and use methods to solve Linear homogeneous PDE with constant coefficient. (K2, K3, K4) CO3: Describe the rules to find complimentary function and particular integral and apply in various cases. (K2, K4) CO4: Evaluate non- homogeneous linear PDE with constant coefficient. (K6)

		CO5: Explain the classification of PDEs of second order and solution of wave equation by using method of separation of variable. (K2, K3, K4) CO6: Explain and evaluate the solution of heat equation in one dimension in various cases and solution of Laplace equation. (K2, K4, K6)	
7	Course Description	This course is an introduce the basic concepts of partial differential equations and introduce students to how to solve linear Partial Differential with different methods. Learn to solve first-order partial differential equations and formation of PDEs. Explore the methods to solve Linear homogeneous and non-homogeneous PDEs with constant coefficients. Students will also master the technique of separation of variables to solve PDEs and able to derive heat and wave equations.	
8	Outline syllabus		CO Mapping
	Unit 1	**Linear PDEs of order one:**	
	A	Formation of partial differential equations (a) by elimination of arbitrary constants	CO1
	B	(b) by elimination of arbitrary function	CO1
	C	Lagrange's method to solve linear PDEs.	CO1
	Unit 2	**Linear homogeneous PDE with constant coefficient:**	
	A	Rules for finding complementary function	CO2, CO3
	B	shortcut methods to find particular integral for standard form of functions	CO3
	C	few general methods for specific forms.	CO3
	Unit 3	**Linear non-homogeneous PDE with constant coefficient:**	
	A	Rules for finding complementary function,	CO4
	B	few shortcut methods to find particular integral for standard form of functions, and few general methods for specific forms	CO4
	C	equations reducible to PDEs with constant coefficients	CO4
	Unit 4	**Classification of PDEs, variable separable method and wave equation:**	
	A	Classification of PDEs of second order, Boundary value problems, the principle of superposition,	CO5
	B	method of separation of variables, its application to solve wave equation	CO5
	C	D'Alembert's solution of wave equation in various cases..	CO5
	Unit 5	**Heat equation and Laplace equation:**	
	A	Solution of heat equation in one dimension in various cases	CO6
	B	solution of Laplace equation in Cartesian coordinates	CO6

	C	its conversion into polar coordinates.			CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1) Ordinary and Partial Differential equations by M. D. Raisinghania, S Chand and Company Ltd. 2) Schaum's Outline series of Partial Differential equations.			
	Other References	1. Elements of Partial Differential Equations by Ian N. Sneddon, McGRA-HILL Book Company.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C311.1	3	3	2	2	2	3	2	2	1	1
C311.2	2	3	3	3	3	2	1	2	1	2
C311.3	2	3	2	2	2	2	2	1	2	2
C311.4	2	3	2	3	2	2	2	2	3	2
C311.5	3	3	2	3	2	1	2	2	2	2
C311.6	3	3	2	2	3	3	2	2	2	2

DISCRETE MATHEMATICS (MSM 312)

School: SBSR		**Batch : 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: V**
1	Course Code	MSM 312

2	**Course Title**	**DISCRETE MATHEMATICS**	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	This course is aimed to provide an advance understanding to the sets and propositions, relations and functions, permutation and combination, graphs, groups and rings.	
6	Course Outcomes	CO1: Discuss the concept of sets, un-countably infinite sets, principle of inclusion and exclusion, multisets, propositions, conditional propositions and evaluate normal forms, Mathematical induction.(K2,K3, K4,K5) CO2: Describe the concept functions, composition of function, invertible functions, discrete properties of binary relations and check the closure of relations. (K3, K6) CO 3: Explain the concept of POSET and lattices, Warshall's algorithm, Equivalence relations and partitions and evaluate Chains, and Anti-chains. Generating Functions, Recurrence relations and discuss linear recurrence relations with constant coefficient, homogeneous solution, total solutions, solutions by method of Generating function. (K2, K4,K5) CO 4: Illustrate the concept permutations and combinations: rule of sum and product, write the algorithms for generation of permutations and combination. (K3, K5,K6) CO 5: Discuss the concept graph, sub-graph, Walks, Path and circuits, Connected graphs, Disconnected graphs and component, evaluate the fundamental circuits, distance, diameters, radius and pendant vertices, rooted and binary trees (K1,K2,K5,K6) CO6: Demonstrate the understanding of Algebraic systems, Group and evaluate Semi-groups, Monoid, Subgroups, Isomorphism and Automorphism. (K2, K5)	
7	Course Description	This course is given the deep knowledge of sets and propositions, relations and functions, permutation and combination, graphs, groups and rings.	
8	Outline syllabus :		CO Mapping
	Unit 1	**Sets and Propositions -**	
	A	Sets, Un-countably infinite sets, Principle of inclusion and exclusion, multisets, propositions,	CO1

	B	Conditional propositions. Logical connectivity, Propositional, calculus,	CO1, CO2
	C	Universal and existential quantifiers, Normal forms, methods of proofs, Mathematical induction.	CO2
	Unit 2	**Relations and Functions -**	
	A	Functions , Composition of function , invertible functions, Discrete properties of binary relations, closure of relations	CO3
	B	Warshall's algorithm, Equivalence relations and partitions, Ordered Sets and Lattices: Introduction, Ordered set,	CO3
	C	Hasse diagram of partially ordered set, Consistent enumeration, Isomorphic ordered set, Well ordered set, Lattices, Properties of lattices, Bounded lattices, Distributive lattices, and Complemented lattices. Chains, and Anti-chains.	CO3
	Unit 3	**Number Theory**	
	A	Counting: Basic counting principles, factorial notation, Binomial coefficients, Ordered and unordered partitions.	CO4
	B	Permutations and combinations : Rule of sum and Product, Permutations, Combination, Algorithms for Generation of Permutations and Combination,	CO4
	C	The Pigeonhole principle, Fundamental theorem of arithmetic, Congruence relation, Congruence Equations.	CO4
	Unit 4	**Recurrence Relations And Algebraic Structures**:	
	A	Discrete Numeric Functions and Generating functions,	CO5
	B	Simple Recurrence relation with constant coefficients	CO5
	C	Linear recurrence relations without constant coefficients, Asymptotic behavior of functions.	CO5
	Unit 5	**Algebraic Structures -**	
	A	Algebraic systems, Group, Semi-groups, Monoid, Subgroups.	CO6
	B	Cyclic group ,Permutation groups, Homomorphism,	CO6
	C	Isomorphism and Automorphism of groups.	CO6
	Mode of examination	Theory	

	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Liu C.L. and Mohapatra, D.P., " Elements of Discrete Mathematics" , SiE edition, TMH, 2008			
	Other References	1. Kenneth H.R.,' Discrete Mathematics and its Applications", Mc-graw hill. 2. Biggs N., "Discrete Mathematics", 3rd edition, Oxford University			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C312.1	3	3	2	2	2	2	2	2	1	1
C312.2	2	3	2	3	3	2	1	2	1	2
C312.3	2	3	2	2	2	2	2	1	2	2
C312.4	2	3	2	3	2	2	2	2	3	2
C312.5	3	3	2	2	2	1	2	2	2	2
C312.6	3	3	2	2	3	3	2	2	2	2

MATHEMATICAL LOGIC BUILDING- II (MSM 314)

School: SBSR		**Batch : 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: V**
1	Course Code	MSM 314

2	**Course Title**	**MATHEMATICAL LOGIC BUILDING- II**	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	Compulsory	
5	Course Objective	To make students familiar with the logical mathematics. The concept of time and work, distance problems, ages, volume and area, analytical reasoning, data interpretation, logical diagrams, resume writing.	
6	Course Outcomes	CO1: Explain and illustrate the concepts of time and work, pipes and cisterns, speed. (K2, K3, K4) CO2: Describe time and distance/trains, boat problems, averages and evaluate. (K1, K2, K3, K5) CO3: Describeproblems on ages, explain and evaluate simple interest and compound interest, volume & surface area. . (K2, K3, K4,K5) CO4: Describe analytical reasoning, assumptions and explain the application of data sufficiency and data interpretation, mean, median, mode & standard deviation. (K2, K3, K4) CO5: Describe the eligibility criterion, cubes and dices, and evaluate line angles & triangles, different types of charts, logical Venn-diagram. (K2, K3, K6) CO6: Describe how to write resume, how to face interview and group discussion. (K1,K2)	
7	Course Description	This course is developing logical mathematics concept. The primary objective of the course is to develop the basic understanding of the concept of time and work, distance problems, ages, volume and area, analytical reasoning, data interpretation, logical diagrams, resume writing.	
8	Outline syllabus :		CO Mapping
	Unit 1		
	A	Time and Work, Pipes and Cisterns,	CO1
	B	Speed, Time and Distance/Trains	CO1, CO2
	C	Boat Problems, Averages.	CO2
	Unit 2		

	A	Problems on Ages			CO3
	B	Simple Interest and Compound Interest,			CO3
	C	Volume & Surface Area.			CO3
	Unit 3				
	A	Analytical Reasoning, Assumptions,			CO4
	B	Data Sufficiency and Data Interpretation,			CO4
	C	Mean, Median, Mode & Standard Deviation.			CO4
	Unit 4				
	A	Eligibility Criterion, Cubes and Dices,			CO5
	B	Line Angles & Triangles, Different Types of Charts,			CO5
	C	Logical Venn diagram.			CO5
	Unit 5				
	A	Resume Writing,			CO6
	B	Interview,			CO6
	C	Group Discussion			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Dr. R.S. Aggarwal, Quantitative aptitude, S. Chand Publication.			
	Other References	1. P.A. Anand, Quantitative aptitude, Wiley publication. 2. Dr. R.S. Aggarwal, A modern approach to verbal & non- verbal reasoning, S. Chand Publication. 3. R. V. Praveen, Quantitative aptitude & reasoning, PHI Publication.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C314.1	2	2	2	3	2	2	2	3	2	1
C314.2	2	2	3	3	2	2	2	2	1	2
C314.3	2	2	2	2	3	2	1	2	2	2
C314.4	2	2	2	3	2	2	2	2	2	2
C314.5	3	2	3	3	2	1	2	1	2	1
C314.6	3	2	2	2	2	2	2	1	2	2

Complex Analysis (MSM 301)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H)		**Current Academic Year: 2020-21**
Branch: Mathematics		**Semester: VI**
1	Course Code	MSM 301
2	Course Title	Complex Analysis
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. This course is aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions, Complex integration and complex power series are presented. Discuss the classification of isolated singularities and examine the theory and illustrate the applications of the calculus of residues in the evaluation of integrals. 2. Students will study geometric properties of conformal mappings in the plane and their relations with analytic functions
6	Course Outcomes	CO1: Calculate continuity, differentiability, analyticity of a function and analyse the derivative of a function. (K3, K4) CO2: Evaluate a contour integral using parameterization, fundamental theorem of calculus and Cauchy's integral formula (K3, K6) CO 3: Develop the Taylor's and Laurent's series of a function and evaluate its circle or annulus of convergence; (K5, K6) CO 4:Caculate the residue of a function and use the residue theory to evaluate a contour integral or an integral over the real line (K3, K6) CO 5: Demonstrate the understanding of conformal mappings and Construct conformal mappings between many kinds of domain. (K2, K5)

		CO 6: Recognize and assess the applications of complex variables. (K1, K6)			
7	Course Description	This course is an introduce the theories for functions of a complex variable. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions, Complex integration and complex power series are presented. Discuss the classification of isolated singularities and examine the theory and illustrate the applications of the calculus of residues in the evaluation of integrals.			
8	Outline syllabus				CO Mapping
	Unit 1				
	A	Complex functions and their limits, continuity, differentiability,			CO1
	B	Analytic function, The C-R equations and sufficient conditions for differentiability and analyticity			CO1
	C	Harmonic functions and harmonic conjugates.			CO1
	Unit 2				
	A	Cauchy's theorem (with proof), Cauchy's integral formula and its applications			CO2
	B	Taylor's series, Laurent expansion of functions			CO3
	C	Singularities and its types, residues.			CO4
	Unit 3				
	A	Residue theorem, applications of residue theorem			CO4
	B	Evaluation of real definite integrals			CO4
	C	Integration around the unit circle and evaluation of some infinite real integrals.			CO4
	Unit 4				
	A	Transformations or mappings, some standard transformations			CO5
	B	Bilinear transformation, fixed point of a transformation			CO5
	C	Conformal transformation, Jacobian of a transformation and few special conformal mappings.			CO5
	Unit 5				
	A	Application of complex conjugate functions			CO6
	B	Flow problems and modelling.			CO6
	C	Flow problems and modelling.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1) Churchill, Ruel V. and Brown, JamesWard, Complex Variables and Applications, fourth edition, McGraw-Hill Book Co., New York, 1984. 2) Conway, John B., Functions of One Complex Variable, II, Graduate Texts inMathematics,			

		159, Springer-Verlag, New York, 1995.	
	Other References	1) Schaum's Outline of Complex Variables, 2ed by By Murray Spiegel, Seymour Lipschutz, John Schiller, Dennis Spellman 2) Ahlfors, Lars V., Complex Analysis: An Introduction to the Theory of Analytic Functions of One Complex Variable, third edition. International Series in Pure and Applied Mathematics, McGraw-Hill Book Co., New York, 1978.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C301.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C301.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C301.3	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**
C301.4	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C301.5	**3**	**2**	**2**	**3**	**3**	**1**	**2**	**2**	**2**	**1**
C301.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

Graph Theory (MSM 308)

School: SBSR		**Batch : 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: VI**
1	Course Code	MSM308
2	Course Title	Graph Theory
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	The objective of the course is to explain basic concepts in combinatorial graph theory. Define how graphs serve as models for many standard problems. Discuss the concept of graph, tree, Euler graph, cut set and Combinatories. see the applications of graphs in science, business and industry.

6	Course Outcomes	CO1: Demonstrate knowledge of the syllabus material. (K2) CO2: Write precise and accurate mathematical definitions of objects in graph theory. (K6) CO3: Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples.(K3, K6) CO4: Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation of questions in graph theory. (K3, K6) CO5:Understand the application in engineering, biology, chemistry, physics. (K2) CO6:Write about graph theory in a coherent and technically accurate manner. (K6)	
7	Course Description	This course will cover the fundamental concepts of Graph Theory: simple graphs, digraphs, Eulerian and Hamiltonian graphs, trees, matchings, networks, paths and cycles, graph colorings, and planar graphs. Famous problems in Graph Theory include: Minimum Connector Problem (building roads at minimum cost), the Marriage Problem (matching men and women into compatible pairs), the Assignment Problem (filling n jobs in the best way), the Network Flow Problem (maximizing flow in a network), the Committee Scheduling Problem (using the fewest time slots), the Four Color Problem (coloring maps with four colors so that adjacent regions have different colors), and the Traveling Salesman Problem (visiting n cities with minimum cost).	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Graph Theory**	
	A	Graph, Subgraph, Various examples of graph and their subgraphs, Walks, Path and circuits, Connected graphs, Disconnected graphs and components	CO1, CO2,CO3
	B	Euler's graphs, various operation on graphs	CO1, CO2,CO3
	C	Hamiltonian Paths and circuits, Traveling salesman problem	CO1, CO2,CO3
	Unit 2	**Trees and its properties**	
	A	Trees and fundamental circuits, distance, diameters, radius and pendant vertices, rooted and binary trees, counting tree	CO1, CO2,CO4
	B	Spanning tree, Fundamental circuits, Finding all spanning trees of a graph	CO1, CO2,CO4
	C	weighted graph, algorithm of prism's, Kruskal's and Dijikistrra's algorithm.	CO1, CO2,CO4
	Unit 3	**Cut-set & Cut-Vertices**	
	A	Cut-sets and cut-vertex , some properties, all cut-sets in a graph, Fundamental circuits and cut-sets, connectivity and separability	CO1,CO2,CO5

	B	Network flows, Planar graph, Combinatorial and geometric dual	CO1, CO2,CO5
	C	Kuratowaski's graphs, Detection of planetary, Geometric dual, Some more criterion of planarity, Thickness and crossing	CO1, CO2,CO5
	Unit 4	**Vector Space of Graphs**	
	A	Vector space of graphs and vectors, bases vector, cut-set vector, circuit vector, circuit and cut-set verses sub-spaces, orthogonal vector and subspaces	CO1, CO2, CO3,CO5
	B	incidence matrix of graph, Sub matrix of A (G)	CO1, CO2, CO3,CO5
	C	Circuit matrix , Cut set matrix, Path matrix and relationship.	CO1, CO2, CO3,CO5
	Unit 5	**Coloring and Covering of Graphs**	
	A	Coloring and covering and partitioning of a graph, Chromatic number, chromatic partitioning, Chromatic polynomials, matching, Covering, 4-color problem	CO5,CO6
	B	Directed graphs, Some types of directed graphs, Directed Path and Connectedness, Euler's digraph, tree with directed edges, Fundamental circuits in digraphs, matrices A, B and C of digraphs adjacency matrices of a Digraph	CO6,CO5
	C	Enumeration, Types of enumeration, Counting of labelled and unlabelled trees, Statement of Poly's theorem.	CO6,CO5
	Mode of examination	Theory	
	Weightage Distribution	CA: 30% / MTE: 20% / ETE: 50%	
	Text book/s*	Deo. N., Graph Theory, PHI	
	Other References	1. Harary. F, Graph Theory, Narosa Publication. 2. Bondy and Murthy, Graph theory and Application. 3. Gross. J., Graph theory and Application., Chapman Hall/crc	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C308.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C308.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**

C308.3	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
C308.4	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C308.5	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**
C308.6	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**

Applied Statistics (MSM 313)

School: SBSR		**Batch: 2020- 2023**
Program: B. Sc. (H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: VI**
1	Course Code.	MSM313
2	Course Title	APPLIED STATISTICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course status	Compulsory
5	Course Objectives	Familiarise students with index numbers methods. Understand the competing merits of different approaches to index number problems and methods for dealing with quality change and new goods. Recognize trend and seasonality in time series data, and estimate/remove these components. Explain process variation and the need to identify special cause variation. Construct 4 attribute charts (p, np, c and u); including calculates control limits, using control constant table, etc.
6	Course Outcomes	CO1: Demonstrate knowledge and understanding of index numbers theory and methods and be able to provide practical solutions to general aggregation problems. (K2, K3) CO2: Demonstrate knowledge and understanding of the competing merits of different approaches to index number problems and methods for dealing with quality change, and be able to choose appropriate methods for use in constructing an index number. (K2, K3) CO3: Demonstrate advanced understanding of the concepts of time series and their application to health, climate, finance and other areas. (K2, K3) CO4: Apply ideas to real time series data and interpret outcomes of analyses. Describe why Statistical Process Control is needed when manufacturing a product. (K2, K3) CO5:Apply the basic tools of statistics and Shewhart rules to interpret a

		control chart and analyze the chart and find out "out of control" state. (K3, K4, K5) CO6: Understand and evaluate the difference between variable and attribute charts. (K2, K6)
7	Course Description	The aim of this module is to provide an understanding of the modern theory and practice of index numbers as a means of making price and quantity comparisons and time Series consist of values of a variable recorded in an order over a period of time. Such data arise in just about every area of science and the humanities, including econometrics and finance, engineering, medicine, genetics, sociology, environmental science. In the section of Statistical Process Control, often referred to as SPC, is a set of tools used for continuous improvement and quality control of an active manufacturing process. A comprehensive coverage of modern quality control techniques to include the design of statistical process control systems, acceptance sampling, and process improvement.
8	Outline syllabus:	
UNIT 1	**Index Numbers**	CO Mapping
A	Introduction, Basic Problems in the construction of Index Numbers.	CO1
B	Construction of Index Numbers.	CO1
C	Measurement Criterion of a good Index Number.	CO1
UNIT 2	**Uses of Index Numbers**	
A	Errors in the construction of Index Numbers.	CO2
B	Uses and Limitations of Index Numbers.	CO2
C	Chain Index, Base Shifting, Splicing and Deflating, Cost of Living Index.	CO2
UNIT 3	**Time Series Analysis**	
A	Economic time series, different components.	CO3
B	Illustration, additive and multiplicative models.	CO3, CO4
C	Determination of trend, seasonal and cyclical fluctuations.	CO4
UNIT 4	**Statistical process and product control**	
A	Quality of a product and need for quality control.	CO4
B	Basic concept of process control, process capability and product control.	CO4
C	General theory of control charts.	CO4, CO5
UNIT 5	**Quality Control Process**	
A	Causes of variation in quality.	CO6
B	Control limits, sub grouping summary of out of control criteria.	CO6
C	Charts for attributes: p chart, np chart, c-chart, Charts for	CO5, CO6

	variables: R, $(\overline{X}, R)$, $(\overline{X}, \sigma)$ charts.			
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. Gupta, S.C., Kapoor, V. K. (2007): Fundamentals of Applied Statistics, 4thEdition, Sultan Chand & Sons. 2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9th Edition, World Press.		
	Other references	3. Croxton, Fredrick E., Cowden, Dudley J. and Klein, S. (1973): Applied General Statistics, 3rd Edition. Prentice Hall of India Pvt. Ltd. 4. Karmel, P.H. and Polasek, M. (2012): Applied Statistics for Economists, 4th edition. Khosla Publishing House by arrangement with Pitman. 5. Mukhopadhyay P. (1999): Applied Statistics, Books and Allied (P) Ltd. 6. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6thEdition, Wiley India Pvt. Ltd.		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C313.1	3	3	2	2	2	3	2	2	1	1
C313.2	2	3	3	3	3	2	1	2	2	2
C313.3	2	3	2	3	2	2	2	1	2	3
C313.4	2	3	2	3	2	2	2	2	3	2
C313.5	3	3	2	3	2	1	2	2	2	2
C313.6	3	3	2	2	3	3	2	2	2	2

METRICS SPACES (MSM 316)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: VI**
1	Course Code	MSM316
2	Course Title	METRICS SPACES

3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	Familiarise students with basic concepts of metric spaces. Give an idea of the Metric space of the real line; subsets of the real line and limit points of sets. Have an understanding of a basis and sub-basis of a Metric space. Discuss a continuous function between two metric spaces and a homeomorphism between them. Know connectedness and compactness and appreciate these concepts in the context of properties of a continuous function.	
6	Course Outcomes	CO1: Explain the concept of a metric and metric spaces and open balls and open sets. (K2, K4) CO2: Apply the concept of convergence of a sequence in metric spaces and Cauchy sequences. (K3) CO3: Explain and use open spheres and close spheres, neighbourhood of a point, open sets, interior points, Limit points, Closed sets and closure of a set, Boundary points, diameter of a set, Subspace of a metric space. (K2, K3, K4) CO4: Explain convergent and Cauchy sequences, Complete metric space and evaluate Dense subsets and separable spaces, Nowhere dense sets, Continuous functions. (K2, K4,K5) CO5: Describe the Compact spaces, Sequential compactness and Bolzano-Weierstrass property, Finite Intersection property. (K1, K2) CO6: Understand and evaluate disconnected and connected sets, connected subsets of R, continuous functions and connected sets. (K2, K6)	
7	Course Description	This course will cover the basic concepts of metric spaces. Give an idea of the Metric space of the real line; subsets of the real line and limit points of sets. Have an understanding of a basis and sub-basis of a Metric space. Discuss a continuous function between two metric spaces and a homeomorphism between them. Know connectedness and compactness and appreciate these concepts in the context of properties of a continuous function.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Metric spaces, open balls, Euclidean space $\mathbb{R}^n$.	CO1, CO2
	B	Convergence of sequences;	CO1, CO2
	C	Continuity	CO1, CO2
	Unit 2		
	A	Definition and example of a metric space. Open and closed spheres, properties, examples.	CO1, CO3
	B	neighbourhood of a point, open sets, interior points,	CO1, CO3

		Limit points, Closed sets and closure of a set,			
	C	Boundary points, diameter of a set, Subspace of a metric space.			CO1, CO3
	Unit 3				
	A	Convergent and Cauchy sequences,			CO1,CO4
	B	Complete metric space, Dense subsets and separable spaces,			CO1,CO4
	C	Nowhere dense sets, Continuous functions.			CO1,CO4
	Unit 4				
	A	Compact spaces, Sequential compactness			CO1, CO2, CO4
	B	Bolzano-Weierstrass property,			CO1, CO2, CO4
	C	Finite Intersection property.			CO1, CO2, CO4
	Unit 5				
	A	Disconnected and connected sets,			CO6,CO5
	B	connected subsets of R,			CO6,CO5
	C	Continuous functions and connected sets.			CO6,CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text books	1. G.F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill, 1963.			
	Other references	1. E.T. Copson: Metric Spaces, Cambridge University Press, 1968. 2. P.K. Jain and Khalil Ahmad: Metric Spaces, Second Edition, Narosa Publishing House, New Delhi, 2003. 3. B. K. Tyagi: First Course in Metric Spaces, Cambridge University Press, 2010.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C316.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C316.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**
C316.3	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**

C316.4	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**
C316.5	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**1**
C316.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

MECHANICS (MSM 306)

School: SBSR		**Batch: 2020- 2023**	
Program: B.Sc.(H)		**Academic Year: 2020-21**	
Branch: Mathematics		**Semester: VI**	
1	Course Code	MSM306	
2	Course Title	MECHANICS	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	Familiarise students with basic concepts of mechanics. Give an idea of the Hook's Law. Given an understanding of a constrained motion, motion in a resisting medium. Discuss the concept of uniform catenary, centre of Gravity.	
6	Course Outcomes	CO1: Explain the concept of velocity acceleration along coordinate Axes. (K2, K4) CO2: Discuss the concept of relation between angular and linear velocities, equation of motion, motion under inverse square law and explain motion of a particle under the attraction of the earth, simple harmonic motion, Hooke's Law (K3) CO3: Explain the use of constrained motion and evaluate motion on the outside of a smooth vertical circle, motion on a rough curve under gravity (K2, K3, K4) CO4: Explain the motion in a resisting medium and planetary motion. (K2, K4,K5) CO5: Describe the uniform catenary and explain tightly stretched string and approximations to a catenary. (K1, K2, K4) CO6: Understand and evaluate centre of gravity of an arc, of a plane area, of a solid of revolution, of surface of revolution. (K2, K6)	
7	Course Description	This course will cover the basic concepts of mechanics. Give an idea of the Hook's Law. Given an understanding of a constrained motion, motion in a resisting medium. Discuss the concept of uniform catenary, centre of Gravity.	
8	Outline syllabus		CO Mapping
	Unit 1		

	A	Velocity and acceleration along coordinate Axes in two dimensions, radial and transverse directions, and along tangential and normal direction			CO1, CO2
	B	Relation between angular and linear velocities, equation of motion, motion under inverse square law			CO1, CO2
	C	Motion of a particle under the attraction of the earth, Simple harmonic motion, Hooke's Law.			CO1, CO2
	Unit 2				
	A	Constrained motion: motion in a smooth vertical circle,			CO3
	B	motion in inside of a smooth fixed hollow sphere from its lowest point,			CO3
	C	Motion on the outside of a smooth vertical circle, motion on a rough curve under gravity.			CO3
	Unit 3				
	A	Motion in a resisting medium: motion of a particle falling under gravity			CO4
	B	Motion of a particle projected vertically upwards			CO4
	C	Planetary Motion: Newton's law of gravitation, motion under the inverse square law, Kepler's laws of planetary motion.			CO4
	Unit 4				
	A	A uniform catenary, Intrinsic equation of the common catenary.			CO5
	B	Cartesian equation of the common catenary,			CO5
	C	Tightly stretched string and approximations to a catenary,			CO5
	Unit 5				
	A	Centre of Gravity: Centre of Gravity of an arc,			CO6
	B	Of a plane area, of a solid of revolution,			CO6
	C	Of surface of revolution.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text books	1. Synge and Griffith : Principle of Mechanics. 2. F. Chorlton : A Text book of Dynamics.			
	Other references	1. S.L. loney : Dynamics of particles and rigid bodies. 2.. A.S. Ramsey : Statics. 3. 5. R.S. Verma : Statics.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C306.1	3	3	2	2	2	3	2	2	1	1
C306.2	2	3	3	3	3	2	1	2	2	2
C306.3	2	3	2	1	2	2	2	1	2	2
C306.4	2	2	2	3	2	2	1	2	2	2
C306.5	3	2	2	3	2	2	2	2	2	1
C306.6	3	3	2	2	3	3	2	2	2	2

Physics Lab 1 (PHB 151) Practical

School: SBSR		Batch: **2020- 2023**
Program: B.Sc.(H).		Academic Year: 2020-21
Branch: Mathematics		Semester: I
1	Course Code	PHB151
2	Course Title	Physics Lab 1
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	To provide students an understanding about fly wheel, compound pendulum. To provide students an understanding of gravity via simple pendulum and compound pendulum setups. To study bending of a beam via stress and strain. To understand the viscous nature of any liquid using Pouselli method.
6	Course Outcomes	CO1: Students will understand simple harmonic motion and its conditions of one dimension. CO2: Students will be able to understand the fly wheel structure and its different applications. CO3: Students will have a clear understanding about depression in a beam via loading it at its one end. CO4: Students will be able to handle travelling microscope, vernier calipers, screw gauge, stop watch also students will gain knowledge of manometer, capillary tube. CO5: Students will learn to measure the height of a building. CO6: Students will learn about modulus of rigidity of a material and moment of inertia also.
7	Course	This course deals with the basic concepts of mechanics. Students

	Description	will be guided to use travelling microscope, vernier calipers, screw gauge, stop watch. This course deals with many different concepts of mechanics via simple experiments.	
8	Outline syllabus		CO Mapping
	Unit 1	Practical's related to gravity	
	a	To measure the acceleration due to gravity using a simple pendulum. And verify the relation. $T = 2\pi\sqrt{\frac{L}{g}}$	CO1, CO4
	b, c	(i) To determine the acceleration due to gravity (g) by means of a compound pendulum. (ii) To determine radius of gyration about an axis through the center of gravity for the compound pendulum.	CO1, CO4
	Unit 2	Practical related to moment of inertia	
	a	To determine the moment of inertia of Flywheel about its axis of rotation.	CO2, CO4, CO6
	b, c	To calculate Moment of inertia of different irregular shapes.	CO2, CO4, CO6
	Unit 3	Practical related to coefficient of viscosity of water	
	a, b, c	To determine the coefficient of viscosity of water by Poiseuille's method.	CO4
	Unit 4	Practical related to measuring of height of a building	
	a, b, c	To determine the height of a building by the help of a Sextant.	CO5
	Unit 5	Practical related to elasticity	
	a	To determine Young's modulus of a material by the bending of abeam clamped at one end and loaded at one of its end by cantilever method.	CO3, CO4
	b, c	To determine the modulus of rigidity of a material of a given wire with an inertia table (torsion pendulum) by dynamical method.	CO6
	Mode of examination	Jury+Practical+Viva	
	Weightage Distribution	CA: 60% / MTE: 0% / ETE: 40%	
	Text book/s*	1. B.Sc.(H). Practical Physics- Harnam Singh, S. Chand Publishing	

	Other References	2. B.Sc.(H). Practical Physics- C L Arora, S. Chand Publishing 3. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C151.1	2	3	2	2	1	2	2	2	2	2
C151.2	3	2	1	1	2	1	2	1	1	2
C151.3	2	2	2	2	1	1	1	2	1	2
C151.4	2	2	2	2	2	2	2	1	2	1
C151.5	2	2	3	2	1	2	1	2	2	2
C151.6	2	1	2	1	2	2	2	1	2	2

Chemistry Lab I (BCH 151)

School: SBSR		**Batch: 2020- 2023**
Program: BSc. (H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: 1**
1	Course number	**BCH-151**
2	Course Title	**Chemistry Lab I**
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
5	Course Objective	To learn methods for quantitative estimation of different chemical species by various volumetric methods and to understand calorimetric formula, heat capacity of calorimeter, water equivalent of calorimeter and enthalpy.
6	Course Outcomes	1. Able to prepare primary standard and secondary standard solutions. 2. Understand the importance of pH and pH meter. 3. Explain the cause of change in thermal energy of a system during any physical or chemical change. 4. Correlate the change in thermal energy with the heat lost or gained by the system. 5. Distinguish between heat capacity and water equivalent of

		calorimeter. 6. Able to understand the colligative properties. 7. Able to understand the concept Kinematic viscosity.	
7	Outline syllabus:		
7.01	CHB 151.01	Task 1	To prepare a standard solution of sodium carbonate (Na_2CO_3) and use it to standardise a given solution of HCl.
7.02	CHB 151.02	Task 2	To determine the strength of given HCl solution by titrating it against 0.1 N Na_2CO_3 solution pH metrically.
7.03	CHB 151.03	Task 3	To determine the heat capacity of the calorimeter.
7.04	CHB 151.04	Task 4	To determine the enthalpy of neutralization of NaOH and HCl.
7.05	CHB 151.05	Task 5	To determine the enthalpy of hydration of anhydrous copper sulphate.
7.06	CHB 151.06	Task 6	Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
7.07	CHB 151.07	Task 7	Study the variation of viscosity of sucrose solution with the concentration of solute using Ostwald viscometer.
7.08	CHB 151.08	Task 8	To demonstrate the colligative property of elevation in boiling point.
7.09	CHYB151.09	Task 9	To demonstrate the colligative property of depression in freezing point.
7.10	CHB 151.10	Task 10	To demonstrate the phenomenon of osmosis using semi permeable membrane.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	**References**		
9.1	Text book	O.P. Pandey, D.N. Bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	1. Eastman. E.D. and Rollefson, G.K. *Physical Chemistry* 1947 ed. McGraw-Hill p307.	

		2. Pauling, Linus: *General Chemistry* 1970 ed. Dover Publications pp459-460. 3. Moore, Walter J. *Physical Chemistry* 1962 ed. Prentice Hall p132.

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C151.1	2	3	2	2	1	2	2	2	2	2
C151.2	3	2	1	1	2	1	2	1	1	2
C151.3	2	2	2	2	1	1	1	2	1	2
C151.4	2	2	2	2	2	2	2	1	2	1
C151.5	2	2	3	2	1	2	1	2	2	2
C151.6	2	1	2	1	2	2	2	1	2	2

Chemistry Lab (BCH 152)

1	Course number	**BCH-152**
2	Course Title	**Chemistry Lab**
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
5	Course Objective	1. To learn methods for, purification and qualitative analysis of organic compounds 2. To execute independently purification techniques to organic compounds like filtration, recrystallization, sublimation and distillation. 3. To perform the qualitative test on unknown organic compounds i.e preliminary tests, tests for extra elements. 4. To understand the basic concept of quantitative analysis for organic compounds 5. To understand the concept of organic acid and perform the acid base titration to calculate their solubility in solvents at room temperature.
6	Course Outcomes	Students are able to 1. Understand the methods of separation and purification

		2. Understand the Qualitative analysis of organic compounds 3. Prepare solutions of different strength and standardize them 4. Execute the volumetric analysis experiments for organic compounds	
7	Outline syllabus:		
7.01	**BCH-152**.01	Task 1	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using: Water solvent (Phthalic acid, Benzoic acid), Determination of the melting points of above compounds and report the yields of pure compounds.
7.02	**BCH-152**.02	Task 2	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using Alcohol (naphthalene), Determination of the melting points of above compounds and report the yields of pure compounds.
7.03	**BCH-152**.03	Task 3	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization Alcohol-Water (Aspirin from tablet), Determination of the melting points of above compounds and report the yields of pure compounds.
7.04	**BCH-152**.04	Task 4	To perform the purification of crude naphthalene by sublimation method and calculate the percentage yield and M.P..
7.05	**BCH-152**.05	Task 5	Purification of organic compounds(Water + acetone) by simple distillation.
7.06	**BCH-152**.06	Task 6	Elimination reaction of 2-pentanol
7.07	**BCH-152**.07	Task 7	Cycloaddition reaction of Cyclopentadiene and maleic anhydride
7.08	**BCH-152**.08	Task 8	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.09	**BCH-152**.09	Task 9	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.10	**BCH-152**.10	Task 10	To determine the solubility of given organic acid(oxalic acid
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	

8.2	MTE	None
8.3	End-term examination: None	
9	References	
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C152.1	2	3	2	2	1	2	2	2	2	2
C152.2	3	2	1	1	2	1	2	1	1	2
C152.3	2	2	2	2	1	1	1	2	1	2
C152.4	2	2	2	2	2	2	2	1	2	1

Physics Lab-2 (PHB 152)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: II**
1	Course Code	PHB152
2	Course Title	**Physics Lab 2 (Optics and Thermal Physics)**
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	1. To provide students an understanding of prism, Fresnel's biprism, and spectrometer. 2. To provide students an understanding of thermal conductivity. 3. To study the thermocouples and also to have knowledge of Stefan's law. 4. Students will learn about plane transmission grating and Newton's ring method.
6	Course Outcomes	After the completion of this course, CO1: Students will learn about the fundamentals of optics i.e. dispersion, diffraction, interference etc. CO2: Students will understand about bad conductor, good conductor and how to determine their thermal conductivity. CO3: Students will learn about thermocouples and their working. CO4: Students will learn about black body radiation through Stefan's law. They will also learn to determine the wavelength of light through plane diffraction grating and Newton's Ring method. . CO5: Students will gain knowledge of lenses and learn to determine the focal length of lenses. CO6: Students will be able to correlate theory and practical together through the experiments and get the clear understanding of the concepts behind them.
7	Course Description	This course will help students to have basic understanding of basics of Optics, Thermal conductivity and blackbody Radiation. It also helps them to understand the working of spectrometer, Newton's ring, plane diffraction grating and Nodal slides.

8	Outline syllabus				CO Mapping
	Unit 1				
	A B C	1. To determine the dispersive power of a material of the prism and its angle using spectrometer. Also calculate speed of light in the given prism. 2. To determine wavelength of monochromatic light source (λ) by Fresnel's biprism			CO1 CO6
	Unit 2				
	A B C	**3.** To determine thermal conductivity of a bad conductor in form of a disc using Lee's method. 4. Calculate the thermal conductivity of copper by Searle's method			CO2 CO6
	Unit 3				
	A B C	5. To calibrate a thermocouple to determine the temperature of a given object. 6. To verify Stefan's law using radiation method.			CO3 CO4 CO6
	Unit 4				
	A B C	7. To determine the wavelength of prominent lines of mercury by plane diffraction grating. 8. To determine the wavelength of monochromatic light by Newton's Ring method.			CO1 CO4 CO6
	Unit 5				
	A B C	9. To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula.			CO5 CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA 60%	MTE 0%	ETE 40%	
	Text book/s*	4. B.Sc.(H). Practical Physics- Harnam Singh, S. Chand Publishing 5. B.Sc.(H). Practical Physics- C L Arora, S. Chand Publishing			
	Other References	1. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C152.1	2	3	2	2	1	1	2	2	1	1
C152.2	1	2	2	2	1	1	2	2	1	1
C152.3	2	3	1	1	2	2	1	1	2	2

C152.4	1	2	2	2	1	2	2	2	1	2
C152.5	2	2	2	1	1	1	2	1	1	1
C152.6	2	2	2	2	2	2	2	2	2	2

Statistics Lab IMSM 250 (Practical)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H).(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: III**
1	Course Code	MSM 250
2	Course Title	Statistics Lab I
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	To familiarize the student in introducing and exploring MS excel. To enable the student on how to approach for solving statistical problems using excel tools. To prepare the students to use excel in their project works. To provide a foundation in use of this MS office for real time applications.
6	Course Outcomes	CO1: Understand the procedures,Analyzing and Visualizing Data with Excel. (K2) CO2: Discuss and develop the basic understanding of creating formulas and how cells are referenced by rows and columns within Excel. (K2, K5, K6) CO3: Discuss and construct table and graph of data with excel. (K2, K5, K6) CO4: Discuss and calculate basic statistical parameters (mean, measures of dispersion, correlation coefficient, indexes). (K2, K5, K6) CO5: Discuss and calculate correlationbetween two variables with excel. (K2, K5, K6) CO6: Discuss, predict and estimate the variable by regression analysis with excel. (K2, K5, K6)
7	Course Description	Enable students for using the computer program MS Excel, apply basic statistical techniques and methods for grouping, tabular and graphical display, analysis and interpretation of Statistical data.

8	Outline syllabus		CO Mapping
	Unit 1	**Lab. Experiment 1:**	

School: SBSR		**Batch: 2020- 2023**			
Program: B.Sc.(H)		**Academic Year: 2020-21**			
Branch: Mathematics		**Semester: III**			
1	Course Code	MSM-251			
2	Course Title	Mathematics Lab I			
3	Credits	2			
		Exploring Data in Excel			CO1, CO2
	Unit 2	**Lab. Experiment 2:**			
		Create Charts			CO1, CO3
	Unit 3	**Lab. Experiment 3:**			
		Calculate Descriptive Statistics			CO1, CO4
	Unit 4	**Lab. Experiment 4:**			
		Calculate Correlation			CO1,CO5
	Unit 5	**Lab. Experiment 5:**			
		Perform Regression			CO1, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C250.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C250.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C250.3	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**3**
C250.4	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**
C250.5	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**
C250.6	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**

4	Contact Hours (L-T-P)	0-0-3			
	Course Status	Compulsory			
5	Course Objective	The goal of this course is to introduce students to the fundamental mathematical concepts for MATLAB. The course will cover the syntax and semantics of MATLAB including control structures, comments, variables, functions etc. Once the foundations of the language have been established students will explore different types of scientific programming problems including curve fitting, ODE solving etc			
6	Course Outcomes	CO1: Describe the fundamentals of MATLAB and use MATLAB for interactive computations. (K2, K3) CO2: Demonstrate with strings and matrices and their uses. (K2, K3) CO3: Illustrate basic flow controls (if-else, for, while). (K3) CO4: Create plots and export this for use in reports and presentations. (K3, K5) CO5: Develop program scripts and functions using the MATLAB development environment. (K4, K5)			
7	Course Description	The course will give the fundamental knowledge and practical abilities in MATLAB required to effectively utilize this tool in technical numerical computations and visualisation in other courses. Syntax and interactive computations, programming in MATLAB using scripts and functions, rudimentary algebra and analysis. One- and two-dimensional graphical presentations. Examples on engineering applications.			
8	Outline syllabus				CO Mapping
	Unit 1	**Practical based** MATLAB as a calculator.			**CO1**
		Creating an Array in MATLAB			CO1
	Unit 2	**Practical related to --** Mathematical Operations with Arrays			**CO3**
	Unit 3	**Practical related to---** How to make scripts files in MATLAB and do some examples.			**CO5**
	Unit 4	**Practical related to---** Make some function files in MATLAB. Basic two-dimensional and three-dimensional plotting, change in axes and annotation in a figure.			**CO4,CO5**
	Unit 5	**Practical related to---** If-End statement, If-Else-End statement, nested If-Else-End statement Solving a system of linear equations, curve fitting with polynomials using inbuilt functions such as polyfit.			**CO2,CO5**
	Mode of examination	Practical &Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book	- An introduction to MATLAB : Amos Gilat			

	Other References	3. Applied Numerical Methods with Matlab for engineering and Scientists by stevenchapra, Mcgraw Hill. 4. Getting started with Matlab: RudraPratap	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C251.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C251.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C251.3	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**3**
C251.4	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**
C251.5	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**

Statistics Lab IIMSM 253 (Practical)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H).(H)		**Academic Year: 2020-22**
Branch: Mathematics		**Semester: IV**
1	Course Code	MSM 253
2	Course Title	Statistics Lab II
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	Introduce basic statistical concepts, logics and analytical tools MS excel. Provide students with a general understanding of descriptive and inferential statistics and the opportunity to apply them to examine business and economic data. Equip students with the skills to apply statistical concepts and analytical tools to analyze and handle real-world business issues. Train students for presenting and exchanging statistical findings and views.
6	Course Outcomes	CO1: Understand, discuss andsummaries of recorded data with excel.(K2)

		CO2: Discuss,explain and identifies the importance of diagrammatic presentation of data. (K2, K5, K6) CO3: Discuss and Explain statistical concepts and use the analytical tools of descriptive statistics with excel. (K2, K5, K6) CO4: Discuss, calculate and understands the nature of curve. (K2, K5, K6) CO5: Discuss, calculate and interpret the correlation between two or more variables with excel. (K2, K5, K6) CO6: Develop a deeper understanding of the linear regression model and its limitations. (K2, K5, K6)			
7	Course Description	This course provides students with basic statistical concepts and analytical tools, and the opportunity to apply them to analyze real-world problem data. Main topics include sampling methods, descriptive statistics, probability & probability distributions, sampling distributions and confidence interval estimation, hypothesis testing, simple linear regression and correlation, time series analysis and applications in quality and production management.			
8	Outline syllabus				CO Mapping
	Unit 1	**Lab. Experiment 1:**			
		Graphical representation of data.			CO1, CO2
	Unit 2	**Lab. Experiment 2:**			
		Problems based on measures of central tendency, measures of dispersion, combined mean and variance and coefficient of variation.			CO1, CO3
	Unit 3	**Lab. Experiment 3:**			
		Problems based on moments, skewness and kurtosis. Fitting of polynomials, exponential curves.			CO1, CO4
	Unit 4	**Lab. Experiment 4:**			
		Find Karl Pearson correlation coefficient, rank correlation with and without ties, Partial and multiple correlations, correlation coefficient for a bivariate frequency distribution. Lines of regression, angle between lines and estimated values of variables. Planes of regression and variances of residuals for raw data.			CO1,CO5
	Unit 5	**Lab. Experiment 5:**			
		Survey on gender ethics using statistical tools.			CO1, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C253.1	3	3	2	2	2	3	2	2	1	1
C253.2	2	3	3	3	3	2	1	2	1	2
C253.3	2	3	2	2	3	2	3	2	2	3
C253.4	2	3	2	3	2	2	2	2	3	2
C253.5	3	3	2	3	2	2	2	2	2	3
C253.6	3	2	3	2	3	2	3	2	3	3

Mathematics Lab II MSM 254 (Practical)

School: SBSR		**Batch: 2020- 2023**
Program: B.Sc.(H).(H)		**Academic Year: 2020-21**
Branch: Mathematics		**Semester: IV**
1	Course Code	MSM 254
2	Course Title	Mathematics Lab II
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	1. To familiarize the student in introducing and exploring MATLAB software. 2. To enable the student on how to approach for solving problems using MATLAB tools. 3. To prepare the students to use MATLAB in their project works. 4To provide a foundation in use of this software for real time applications.
6	Course Outcomes	CO1: Understand the procedures, algorithms, and concepts require to solve specific problems. (K2) CO2: Discuss and develop the algorithms to solve system of linear equations and measure the accuracy. (K2, K5, K6) CO3: Discuss and develop the algorithms to solve finite differences and interpolation and measure the accuracy. (K2, K5, K6) CO4: Discuss and develop the algorithms to solve system of transcendental equations and measure the accuracy. (K2, K5, K6) CO5: Discuss and develop the algorithms to solve divided differences and

		measure the accuracy. (K2, K5, K6) CO6: Discuss and develop the algorithms to solve numerical differentiation and integration and measure the accuracy. (K2, K5, K6)			
7	Course Description	This course teaches computer programming to those with little to no previous experience. It uses the programming system and language called MATLAB to do so because it is easy to learn, versatile and very useful for engineers and other professionals. MATLAB is a special-purpose language that is an excellent choice for writing moderate-size programs that solve problems involving the manipulation of numbers.			
8	Outline syllabus				CO Mapping
	Unit 1	**Lab. Experiment 1:**			
		Solution of system of linear equations:			CO1, CO2
	Unit 2	**Lab. Experiment 2:**			
		System of Transcendental equations			CO1, CO3
	Unit 3	**Lab. Experiment 3:**			
		Finite differences and interpolation:			CO1, CO4
	Unit 4	**Lab. Experiment 4:**			
		Divided differences:			CO1,CO5
	Unit 5	**Lab. Experiment 5:**			
		Numerical differentiation and integration			CO1, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	Amos Gilot			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C254.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C254.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C254.3	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**
C254.4	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**
C254.5	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**2**
C254.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

Mathematics Lab III (MSM 355) (Practical)

School: SBSR		**Batch: 2020- 2023**			
Program: B.Sc.(H)		**Academic Year: 2020-21**			
Branch: Mathematics		**Semester: V**			
1	Course Code	MSM 355			
2	Course Title	Mathematics Lab III			
3	Credits	2			
4	Contact Hours (L-T-P)	0-0-3			
	Course Status	Compulsory			
5	Course Objective	To create understanding of the excel and enable the students how to solve LPP, transportation problem, assignment problem in excel.			
6	Course Outcomes	CO1: Understand the basic working concept of excel. (K2) CO2: Discuss and explain the method to solve LPP in excel. (K2, K4, K6) CO3: Explain and solve LPP by Simplex Method in excel. (K2, K4, K6) CO4: Describe how solve TP in excel. (K1, K2, K6) CO5: Discuss and solve AP in excel. (K2,K4, K6)			
7	Course Description				
8	Outline syllabus				CO Mapping
	Unit 1	**Lab. Experiment 1:**			
		Basic working in Excel.			CO1, CO2
	Unit 2	**Lab. Experiment 2:**			
		Solve LPP By Simplex Method			CO3
	Unit 3	**Lab. Experiment 3:**			
		Solve TP in excel			CO4
	Unit 4	**Lab. Experiment 4:**			
		Solve AP in excel			CO5
	Mode of examination	Practical			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C355.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**

C355.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C355.3	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**
C355.4	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**
C355.5	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**2**

Mathematics Lab IV MSM 356 (Practical)

School: SBSR		**Batch: 2020- 2023**	
Program: B.Sc.(H).(H)		**Academic Year: 2020-21**	
Branch: Mathematics		**Semester: VI**	
1	Course Code	MSM 356	
2	Course Title	Mathematics Lab IV	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	To create understanding of the LaTeXand enable the students how to write resume, write question paper, write articles/ research papers.	
6	Course Outcomes	CO1: Understand the procedures installation of the software LaTeX. (K2) CO2: Discuss and explain Latex basic syntax and write equations, matrix, and tables. (K2, K4, K6) CO3: Explain and write page layout, equation references citation tables of contents list of figures etc. (K2, K4, K6) CO4: Describe how to write Geometry, Hyperref, amsmath, amssymb, algorithms in Latex. (K1, K2, K6) CO5: Discuss the classes and explain how to write article, book, report, beamer, slides. IEEtran.. (K2,K4, K6) CO6: Write resume, question paper, research paper, project in Latex . (K2, K5, K6)	
7	Course Description	This course teaches the LaTeXTo and describes how to write resume, write question paper, and write articles / research papers.	
8	Outline syllabus		CO Mapping
	Unit 1	**Lab. Experiment 1:**	
		Installation of the software LaTeX	CO1, CO2
		Understanding Latex compilation: Basic Syntex, Writing equations, Matrix, Tables	
	Unit 2	**Lab. Experiment 2:**	
		Page Layout – Titles, Abstract Chapters, Sections, References, Equation references, citation. List making environments Table of contents, Generating new commands, Figure	CO3

		handlingnumbering, List of figures, List of tables, Generating index.			
	Unit 3	**Lab. Experiment 3:**			
		Packages: Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color, tilez listing.			CO4
	Unit 4	**Lab. Experiment 4:**			
		Classes: article, book, report, beamer, slides. IEEtran.			CO5
	Unit 5	**Lab. Experiment 5:**			
		Applications to: Writing resume Writing question paper Writing articles/ research papers			CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	LATEX for Beginners			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C356.1	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**
C356.2	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**
C356.3	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**
C356.4	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**
C356.5	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**2**
C356.6	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**

Project I (MSM 361)

School: SBSR		**Batch : 2020- 2023**	
Program: B.Sc.(H). (H)		**Academic Year: 2020-21**	
Branch: Mathematics		**Semester: V**	
1	Course Code	MSM 361	
2	Course Title	Project I	
3	Credits	3	

4	Contact Hours (L-T-P)	0-0-3			
	Course Status	Compulsory/Elective			
5	Course Objective	1.Deep knowledge of a specific area of specialization. 2.Develop communication skills especially in project writing and oral presentation. Develop some time management skills.			
6	Course Outcomes	**CO1:** Explain the concept of research within the subject, as regards approaching a question, collecting and analysing background material and presenting research questions and conclusions. (K2, K4) **CO2:** Construct and develop a deeper interest in mathematics and taste for research. (K5, K6) **CO3:** Select and recommend the activities that support their professional goals. (K4, K6) **CO4:** Develop effective project organizational skills. (K5)			
7	Course Description	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.			
8	Outline syllabus				CO Achievement
	Unit 1	**Introduction**			**CO1**
	Unit 2	**Case study**			**CO1,CO2**
	Unit 3	**Conceptual**			**CO2,CO3**
	Unit 4	**Development**			**CO3**
	Unit 5	**Finalisation**			**CO3,CO4**
	Mode of examination	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C361.1	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**
C361.2	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**

C361.3	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**
C361.4	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**2**

Project- II (MSM 362)

School: SBSR		**Batch : 2020- 2023**			
Program: B.Sc.(H).		**Academic Year: 2020-21**			
Branch: Mathematics		**Semester: VI**			
1	Course Code	MSM 362			
2	Course Title	Project II			
3	Credits	3			
4	Contact Hours (L-T-P)	0-0-3			
	Course Status	Compulsory/Elective			
5	Course Objective	1.Deep knowledge of a specific area of specialization. 2.Develop communication skills especially in project writing and oral presentation. Develop some time management skills.			
6	Course Outcomes	**CO1:** Explain the concept of research within the subject, as regards approaching a question, collecting and analysing background material and presenting research questions and conclusions. (K2, K4) **CO2:** Construct and develop a deeper interest in mathematics and taste for research. (K5, K6) **CO3:** Select and recommend the activities that support their professional goals. (K4, K6) **CO4:** Develop effective project organizational skills. (K5)			
7	Course Description	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.			
8	Outline syllabus				CO Achievement
	Unit 1	**Introduction**			**CO1**
	Unit 2	**Case study**			**CO1,CO2**
	Unit 3	**Conceptual**			**CO2,CO3**
	Unit 4	**Development**			**CO3**
	Unit 5	**Finalisation**			**CO3,CO4**
	Mode of examination	Jury/Practical/Viva			
	Weightage	CA	MTE	ETE	

	Distribution	60%	0%	40%	
	Text book/s*	-			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C362.1	3	3	2	3	2	3	2	3	2	2
C362.2	2	3	3	3	3	2	3	2	2	3
C362.3	2	3	2	3	2	2	3	3	2	3
C362.4	2	3	2	3	2	3	2	2	3	2
