B.Sc. (Hons.) MATHEMATICS

Scheme and Syllabus

Outcome Based Education System (OBES)/

Learning Outcomes based Curriculum Framework (LOCF)

Choice Based Credit System (CBCS)

ACADEMIC SESSION

(w.e.f. 2021-2022)

DEPARTMENT OF MATHEMATICS

FACULTY OF SCIENCES

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA,
FARIDABAD HARYANA -121006

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

VISION

J C BOSE University of Science and Technology, YMCA aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

DEPARTMENT OF MATHEMATICS

VISION

To emerge as a department of science, which will provide strong foundations in the areas of Pure and Applied Mathematics in order to develop innovative minds for interdisciplinary research.

MISSION

- To develop strong communication skills among students.
- To develop strong moral values.
- To develop strong foundations in mathematics to have sound analytical and critical thinking ability for innovative solutions in practical problems.
- To continuously improve the basic infrastructure in pursuit of providing necessary environment for academic excellence.
- To develop a nurturing environment for lifelong learning.

ABOUT THE PROGRAM: B.Sc. (Hons.) Mathematics

B.Sc. (Hons.) Mathematics is a three-year undergraduate program which is being divided into six semesters. This degree has been awarded to those who complete the program. In this degree, candidates get a deeper knowledge of mathematics through a vast preference of subjects such as algebra, real analysis, analytic geometry, complex analysis, mechanics, set theory, differential equations etc.

Bachelor of Science is abbreviated as ´B.Sc.´ is one of the most popular undergraduate courses in India. With the advancements in the field of science and technology, this course has become an inevitable course in colleges of India. Students with academic background of science at their 10+2 level with mathematics as one of the subject can pursue this course in different branches. In this field of science, undergraduates are taught to acquire higher level of understanding using scientific analysis, experimentation and application of scientific principles to solve various scientific issues.

PROGRAM OUTCOMES OF UG PROGRAM OF FACULTY OF SCIENCES

PO1	**Knowledge**	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO2	**Research Aptitude**	Capability to ask relevant/appropriate questions for identifying, formulating and analyzing the research problems and to draw conclusion from the analysis
PO3	**Communication**	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large
PO4	**Problem Solving**	Capability of applying knowledge to solve scientific and other problems
PO5	**Individual and Team Work**	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO6	**Investigation of Problems**	Ability of critical thinking, analytical reasoning and research-based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO7	**Modern Tool usage**	Ability to use and learn techniques, skills and modern tools for scientific practices
PO8	**Science and Society**	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices
PO9	**Life-Long Learning**	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life
PO10	**Ethics**	Capability to identify and apply ethical issues related to one's work, avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work
PO11	**Project Management**	Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects

PROGRAM SPECIFIC OUTCOMES (PSOs)

The program specific outcomes (PSO's) are the statement of competencies/abilities that describes the knowledge and capabilities of the post-graduate will have by the end of program studies.

After successful completion of B. Sc. (Hons.) Mathematics, the students will be able to

PSO1	Acquire an understanding and in-depth knowledge of core areas of mathematics like algebra, calculus, geometry, differential equations. This also leads to study of related areas like computer science and statistics. Thus, this programme helps learners in building a solid foundation for higher studies in mathematics
PSO2	Learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society. They will be capable to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of Mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of Mathematics to non-mathematicians.
PSO3	Attain abilities of critical thinking, problem mapping and solving using fundamental principles of Mathematics, systematic analysis and interpretation of results, and unambiguous oral and writing/presentation skills. This programme has a strong foundation in basic and practical aspects of Mathematics enabling the students to venture into research in front-line areas of mathematical sciences, to pursue higher studies in Mathematics, and to enhance their employability for teaching jobs, government jobs, jobs in banking, insurance and investment sectors, data analyst jobs etc.

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA
FARIDABAD
DEPARTMENT OF MATHEMATICS
SCHEME B.Sc. (Hons.) MATHEMATICS
(6 SEMESTER COURSE)

SEMESTER I

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BMH-101A	Calculus	4	0	0	25	75	100	4	DCC
BMH-102A	Algebra	5	1	0	25	75	100	6	DCC
BMH-103A	Calculus (Lab)	0	0	4	15	35	50	2	DCC
Ability Enhancement Compulsory Course (AECC) – Compulsory									
BENG-101A	English	2	0	0	25	75	100	2	AEC
Open Elective Course (OEC-1) * - Select one course along with respective Lab from the following discipline:									
OPHY-101A	Fundamentals of Electricity & Magnetism	4	0	0	25	75	100	4	OEC
OCSC-101A	Introduction to programing	4	0	0	25	75	100	4	OEC
OCHE-101A	Inorganic Chemistry	4	0	0	25	75	100	4	OEC
OPHY-102A	Electricity & Magnetism (Lab)	0	0	4	15	35	50	2	OEC
OCSC-102A	Introduction to Programing (Lab)	0	0	4	15	35	50	2	OEC
OCHE-102A	Inorganic Chemistry (Lab)	0	0	4	15	35	50	2	OEC
Massive Open Online Course (MOOC)**- Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**20**	

*OEC- A student has to choose one course out of the given courses and he/ she will continue with open elective courses from the same discipline during Sem-I to Sem-IV.

**The students have to pass at least one mandatory MOOC course with 4-6 credits (12-16 weeks) from the list given on the Swayam portal or the list given by the Department/ University from 1st semester to 5th semester as notified by the University. (Instructions to students overleaf)

L – Lecture; T - Tutorial; P - Practical

SEMESTER II

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BMH- 201A	Real Analysis	5	1	0	25	75	100	6	DCC
BMH- 202A	Differential Equations	4	0	0	25	75	100	4	DCC
BMH- 203A	Differential Equations (Lab)	0	0	4	15	35	50	2	DCC
Ability Enhancement Compulsory Course (AECC) – Compulsory									
BEVS-101A	Environmental Science	2	0	0	25	75	100	2	AEC
Open Elective Course (OEC-2) - Select one course along with respective Lab from the following discipline									
OPHY-201A	Fundamentals of Mechanics	4	0	0	25	75	100	4	OEC
OCSC-201A	Introduction to Database System	4	0	0	25	75	100	4	OEC
OCHE-201A	Physical Chemistry	4	0	0	25	75	100	4	OEC
OPHY-202A	Mechanics (Lab)	0	0	4	15	35	50	2	OEC
OCSC-202A	Introduction to Database System (Lab)	0	0	4	15	35	50	2	OEC
OCHE-202A	Physical Chemistry (Lab)	0	0	4	15	35	50	2	OEC
Massive Open Online Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Mandatory Audit Course (MAC)									
XXX	Audit Course	2	0	0	25	75	100	0	AUD
Total Credits								**20**	

As per the list provided on the University website

SEMESTER III

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BMH- 301A	Probability and Statistics	5	1	0	25	75	100	6	DCC
BMH- 302A	Group Theory	5	1	0	25	75	100	6	DCC
BMH- 303A	Multivariate Calculus	4	0	0	25	75	100	4	DCC
BMH- 304A	Multivariate Calculus (Lab)	0	0	4	15	35	50	2	DCC
Skill Enhancement Course (SEC) – Select one course from the following:									
SEC-301A	Latex	2	0	0	25	75	100	2	SEC
SEC-302A	French –I	2	0	0	25	75	100	2	SEC
SEC-303A	German- I	2	0	0	25	75	100	2	SEC
SEC-304A	Elementary Statistical Techniques	2	0	0	25	75	100	2	SEC
Open Elective Course (OEC-3) – Select one course along with respective Lab from the following discipline:									
OCSC-301A	Computer Networks & Internet Technology	4	0	0	25	75	100	4	OEC
OPHY-301A	Fundamentals of Waves & Optics	4	0	0	25	75	100	4	OEC
OCHE-301A	Organic Chemistry	4	0	0	25	75	100	4	OEC
OCSC-302A	Computer Networks & Internet Technology (Lab)	0	0	4	15	35	50	2	OEC
OPHY-302A	Wave & Optics (Lab)	0	0	4	15	35	50	2	OEC
OCHE-302A	Organic Chemistry (Lab)	0	0	4	15	35	50	2	OEC
Massive Open Online Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**26**	

SEMESTER IV

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BMH- 401A	Analytical Geometry	5	1	0	25	75	100	6	DCC
BMH- 402A	Ring Theory & Linear Algebra	5	1	0	25	75	100	6	DCC
BMH- 403A	Partial Differential Equations	4	0	0	25	75	100	4	DCC
BMH- 404A	Partial Differential Equations (Lab)	0	0	4	15	35	50	2	DCC
Skill Enhancement Course (SEC) – Select one course from the following discipline:									
SEC-401A	Seminar	2	0	0	25	75	100	2	SEC
SEC-402A	French-II	2	0	0	25	75	100	2	SEC
SEC-403A	German –II	2	0	0	25	75	100	2	SEC
SEC-404A	Basics of Operating System	2	0	0	25	75	100	2	SEC
Open Elective Course (OEC-4) - Select one course along with respective lab from the following discipline:									
OCSC-401A	Information Security	4	0	0	25	75	100	4	OEC
OPHY-401A	Fundamentals of Nuclear and Particle Physics	5	1	0	25	75	100	6	OEC
OCSC-402A	Information Security (Lab)	0	0	4	15	35	50	2	OEC
Massive Open Online Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
MOOC	4/6	0			25		100	4/6	MOOC
Total Credits								20	

Massive Open Online Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to V sem.

SEMESTER V

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory Papers									
BMH- 501A	Mechanics-I	5	1	0	25	75	100	6	DCC
BMH- 502A	Numerical Methods	4	0	0	25	75	100	4	DCC
BMH- 503A	Numerical Methods Lab	0	0	4	15	35	50	2	DCC
Discipline Elective Course (DEC) - Select any two courses from the following:									
DEMH- 501A	Discrete Mathematics	5	1	0	25	75	100	6	DEC
DEMH- 502A	Mathematical Modeling	5	1	0	25	75	100	6	DEC
DEMH- 503A	Special Functions and Integral Transform	5	1	0	25	75	100	6	DEC
DEMH- 504A	Application of Algebra & Graph Theory	5	1	0	25	75	100	6	DEC
DEMH-505A	Linear Programming	5	1	0	25	75	100	6	DEC
Massive Open Online Course (MOOC) – Online Compulsory Course in any one semester from Sem I to Sem V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**24**	

SEMESTER VI

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory Papers									
BMH- 601A	Complex Analysis	4	0	0	25	75	100	4	DCC
BMH- 602A	Set Theory and Metric Space	5	1	0	25	75	100	6	DCC
BMH- 603A	Complex Analysis (Lab)	0	0	4	15	35	50	2	DCC
Discipline Elective Course (DEC) – Select any two courses from the following:									
DEMH-601A	Financial Mathematics	5	1	0	25	75	100	6	DEC
DEMH-602A	Mechanics-II	5	1	0	25	75	100	6	DEC
DEMH-603A	Riemann Integral	5	1	0	25	75	100	6	DEC
DEMH-604A	Number Theory	5	1	0	25	75	100	6	DEC
Total Credits								**24**	

Grand Total Credits: 144/146 [140+ 4/6 (for MOOC Course)]

NOTE: 1. Discipline Elective Course (DEC) papers may be added or deleted as per UGC guidelines.
2. Skill Enhancement Course (SEC) papers may be added or deleted as per UGC guidelines.

Instructions to the students regarding MOOC

1. Two types of courses will be circulated: branch specific and general courses from the website https://swayam.gov.in or https://nptel.ac.in/ in the month of June and November every year for the forthcoming semester.
2. The department coordinators will be the course coordinators of their respective departments.
3. Every student has to pass a selected MOOC course within the duration as specified below:

Programme	**Duration**
B. Tech.	Sem. I to Sem. VII
M.Sc./M. Tech./MA/MBA	Sem. I to Sem. III
B.Sc./MCA	Sem. I to Sem. V

The passing of a MOOC course is mandatory for the fulfillment of the award of the degree of concerned programme.

4. A student has to register for the course for which he is interested and eligible which is approved by the department with the help of course coordinator of the concerned department.
5. A student may register in the MOOC course of any programme. However, a UG student will register only in UG MOOC courses and a PG student will register in only PG MOOC courses.
6. The students must read all the instructions for the selected course on the website, get updated with all key dates of the concerned course and must inform his/her progress to their course coordinator.
7. The student has to pass the exam (online or pen-paper mode as the case may be) with at least 25% marks.
8. The students should note that there will be a weightage of Assessment/quiz etc. and final examination appropriately as mentioned in the instructions for a particular course.
9. A student must claim the credits earned in the MOOC course in his/her mark sheet in the examination branch by forwarding his/her application through course coordinator and chairperson.

Grading Scheme

*Percentage	Grade	Grade Points	Category
90-100	O	10	Outstanding
80-90	A+	9	Excellent
70-80	A	8	Very Good
60-70	B+	7	Good
50-60	B	6	Above Average
45-50	C	5	Average
40-45	P	4	Pass
<40	F	0	Fail
.....	Ab	0	Absent

***Lower limit included, upper limit excluded**

The multiplication factor for CGPA is 10

1. Automatic Rounding
2. Average difference between actual percentage and CGPA percentage ± 2.5%
3. Worst case difference between actual percentage and CGPA percentage ± 5% if somebody in all the 8 semesters in all the exams (around 75 in numbers) consistently scores at the bottom of the range, say 55 of 55-65 which is a very remote possibility

Syllabus of B. Sc. (Hons.) Mathematics

Semester I

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: BMH-101A
SUBJECT NAME: Calculus

NO. OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

Students will be able to

CO1: Calculate the limit and examine the continuity of a function at a point
CO2: Understand various mean value theorems for differentiable functions
CO3: Expand some simple functions as their Taylor and Laurent series
CO4: Sketch curves in Cartesian and polar coordinate system

UNIT – I

ε-δ definition of limit of a real valued function, Limit at infinity and infinite limits, Continuity of a real valued function, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, L'Hôpital's rule.

UNIT – II

Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation, Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems, Successive differentiation, Leibnitz's theorem.

UNIT - III

Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange, Cauchy and Roche–Schlomilch forms of remainder, Curvature.

UNIT - IV

Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes, Symmetry, Concavity and convexity, Points of inflection, First derivative test, Second derivative test, Curve sketching, Tangents at origin, Tracing of parametric curves, Polar coordinates, Tracing of curves in polar coordinates.

TEXT BOOKS

1. Howard Anton, I. Bivens and Stephan Davis, *Calculus*, 10th edition, Wiley India, 2016.
2. George B. Thomas Jr., Joel Hass, Christopher Heil and Maurice D. Weir, *Thomas' Calculus*, 14th edition, Pearson Education, 2018.
3. Gabriel Klambauer, *Aspects of Calculus*, Springer-Verlag, 1986.

REFERENCE BOOKS

1. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, *Calculus,* 3rd edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. George B. Thomas and R.L. Finney, *Calculus*, 9th edition, Pearson Education, Delhi, 2005.
3. Gorakh Prasad, *Differential Calculus*, 19th edition, Pothishala Pvt. Ltd, 2016.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Calculus (BMH-101A)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	3	3	2	2	3	3	3	3
CO2	3	3	3	3	3	2	2	3	2	3	2	3	3	2
CO3	3	3	3	3	3	2	3	2	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3	3
Average	3	2.75	3	2.75	3	2	2.75	2.75	2.5	2.75	2.5	3	3	2.75

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: BMH-102A
SUBJECT NAME: Algebra

NO. OF CREDITS: 6

L	T	P
5	1	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

This course will enable the students to

CO1: Explore different type of matrices
CO2: Have knowledge of system of Linear Equations, Echelon form
CO3: Know importance of rank of a Matrix, Eigen Values and Eigen Vectors
CO4: Find roots of cubic polynomials

UNIT – I

Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrix. Rank of a matrix. Inverse of a matrix. Linear dependence and independence of rows and columns of a matrix. Row rank and column rank of a matrix. Eigen values, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

UNIT – II

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices.

UNIT –III

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.

UNIT-IV

Nature of the roots of an equation Descarte's rule of signs. Solutions of cubic equations (Cordon's method). Biquadratic equations and their solutions.

TEXT BOOKS

1. Punam Kashyap, Yogesh K. Goyal, Mithlesh Gupta and Arpana Garg, *Algebra*, 3rd Edition, JBS Publishers, 2019.
2. Seymour Lipschutz and Marc L. Lipson, *Schaum's outline of Linear Algebra*, 4th Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1. Sudesh K. Shah and Subhash C. Garg, *A Textbook of Algebra*, 1st Edition, Vikas Publishing House Pvt. Ltd., 2017.
2. David C. Lay, *Linear Algebra and its Applications*, 3rd Edition, Pearson Education Asia, Indian Reprint, 2007.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Algebra (BMH-102A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO1	PSO3
CO1	3	2	3	3	3	2	3	3	2	2	3	3	3	3
CO2	3	3	3	2	3	2	2	3	2	3	2	3	3	2
CO3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

CO4	3	2	3	3	2	3	3	3	2	3	3	3	3	2
Average	3	2.5	3	2.75	2.75	2.25	2.75	3	2.25	2.75	2.75	3	3	2.25

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: BMH21-103
SUBJECT NAME: Calculus Lab

NO. OF CREDITS: 2

L	T	P
0	0	4

Internal Assessment: 15
End Semester: 35
Total: 50

Practical/Lab work to be performed on a computer:

Modeling of the following problems using Matlab/Mathematica etc.

1. Plotting of graphs of function of type (greatest integer function, even and odd positive integer, even and odd positive integer, a positive integer) . Discuss the effect of and on the graph.

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

3. Tracing of conics in Cartesian coordinates.

4. Obtaining surface of revolution of curves.

5. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian co-ordinates.

6. To find numbers between two real numbers and plotting of finite and infinite subset of R.

7. Matrix operations (addition, multiplication, inverse, transpose, determinant, rank, eigenvectors, eigen values, Characteristic equation and verification of Cayley Hamilton equation, system of linear equations).

8. Graph of Hyperbolic functions.

9. Computation of limit, differentiation and integration of vector functions.

10. Complex numbers and their representations, operations like addition, multiplication, division, modulus. Graphical representations of polar form

Ability Enhancement Compulsory Course (AECC)
B.Sc. (H) MATHEMATICS
SEMESTER- I
CODE: BENG-101A
SUBJECT NAME: English
NO OF CREDITS: 2

L	T	P
2	0	0

Internal Assessment:	25
End Semester:	75
Total:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

Students will be able to

CO1: Identify different modes of communication
CO2: Analyze about barriers to communication and ways to overcome them
CO3: Have better skills in spoken and written communication including translations
CO4: Comprehend, analyze and interpret information for effective communication

UNIT-I
Introduction: Theory of Communication, Types and modes of Communication.

UNIT-II
Language of Communication: Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication.

UNIT-III

Speaking Skills: Monologue Dialogue Group Discussion Effective Communication/ Mis-Communication Interview Public Speech.

UNIT-IV

Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts. Writing Skills Documenting Report Writing Making notes Letter writing.

REFERENCE BOOKS

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas, Primus books, 2016.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: OPHY-101A
SUBJECT NAME: Fundamentals of Electricity and Magnetism
NO OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment:	25
End Semester:	75
Total:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
After the completion of the course, students will be able to

CO1: Know the basic concepts of electric field and potential
CO2: Have knowledge of dielectric behavior of matter
CO3: Learn the laws of magnetism and electromagnetic induction
CO4: Have an understanding of electromagnetic wave propagation.

UNIT-I
Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

UNIT-II
Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to infinite line, splane and charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per UNIT volume in electrostatic field.

UNIT-III
Electric Field in Dielectrics: Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.
Magnetism: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.
Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro- magnetic materials.

UNIT-IV

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves.

REFERENCE BOOKS

1. Electricity and Magnetism, Edward M. Purcell, McGraw-Hill Education, 1986.
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, Oxford Univ.Press, 1991.
3. Electricity and Magnetism, D C Tayal, Himalaya Publishing House, 1988.
4. University Physics, Ronald Lane Reese, Thomson Brooks/Cole, 2003.
5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, Benjamin Cummings,1998.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: OCSC-101A
SUBJECT NAME: Introduction To Programming
NO. OF CREDITS: 04

L	T	P
4	0	0

Internal Assessment:	25
End Semester:	75
Total:	100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES :

After the completion of the course, students will be able to

CO1: Differentiate between Procedure-Oriented programming and Object-Oriented programming

CO2: Have understanding the syntax of the language

CO3: Implement various object oriented features like inheritance, data abstraction encapsulation and polymorphism to solve various computing problems using C++ language

CO4: Apply object oriented concepts in real world programs

UNIT-I

Introduction to C and C++ :

History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main() function, Compiling and Executing Simple Programs in C++.

Data Types, Variables, Constants, Operators and Basic I/O:

Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).

UNIT-II

Expressions, Conditional Statements and Iterative Statements :

Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative).

Functions and Arrays:
Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters,
Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions. Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use various types of arrays (integer, float and character arrays / Strings) Two- dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays.

UNIT-III
Derived Data Types (Structures and Unions**) :**
Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures.

File I/O :
Opening and closing a file , Reading and writing Text Files, Using put(), get(), read() and write() functions.

UNIT-IV
Using Classes in C++ :
Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Specifying the Protected and Private Access, Copy Constructors,.

Inheritance and Polymorphism :
Introduction to Inheritance and Polymorphism.

REFERENCE BOOKS

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
2. Sharma A. K., “Computer Fundamentals and Programming in C “, 2018
3. Kanetkar Yashavant P. ,”Let us C”, BPB Publications, 2010.
4. Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill, 2017.
5. E. Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
6. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: OCHE-101A
SUBJECT NAME: Inorganic Chemistry
NO OF CREDITS: 4

		Internal Assessment: 25
L	**P**	End Semester: 75
4	0	Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
After the successful completion of the course the learner would be able to

CO1: Have understanding the basic concept of atomic structure
CO2: Explore the chemical bonding concept
CO3: Analyze the bonding and structure in organometallic compounds
CO4: Explain the role of inorganic chemistry in biological systems

UNIT-I
Atomic Structure**:** Review of Bohr's theory and its limitations, Heisenberg Uncertainty principle. Dual behaviour of matter and radiation, de-Broglie's relation. Hydrogen atom spectra. Need of a new approach to Atomic structure.
What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*).
Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

UNIT-II
Chemical Bonding and Molecular Structure
Ionic Bonding*:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice

energy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR (H2O, NH3, PCl5, SF6, ClF3, SF4) and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s*-*s*, *s*-*p* and *p*-*p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods

(including idea of *s*-*p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.

UNIT-III

Organometallic Compounds:

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeise'ssalt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

UNIT-IV

Bio-Inorganic Chemistry:

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{+2} ions: Na/K pump; Role of Mg^{+2} ions in energy production and chlorophyll. Role of iron in oxygen transport, haemoglobin, myoglobin, storage and transport of iron.

REFERENCE BOOKS

1. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.17, 2008.
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley, 3rd Ed., 1995.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley, 3rd Ed. 1994.
4. James E. Huheey, Ellen Keiter and Richard Keiter: *Inorganic Chemistry:* Principles of *Structure and Reactivity*, Pearson Publication, 1997.
1.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: OPHY-102A
SUBJECT NAME: Electricity and Magnetism (Lab)
NO OF CREDITS: 2

		Internal Assessment:	35
L	**P**	End Semester:	15
0	4	Total:	50

At least 5 experiments from the following:

1. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
2. To compare capacitances using De'Sauty's bridge.
3. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
4. To study the Characteristics of a Series RC Circuit.
5. To study a series LCR circuit LCR circuit and determine its
   (a) Resonant frequency,
   (b) Quality factor.
6. To study a parallel LCR circuit and determine its
   (a) Anti-resonant frequency and
   (b) Quality factor Q.
7. To determine a Low Resistance by Carey Foster's Bridge.
8. To verify the Thevenin and Norton theorems.
9. To verify the Superposition and Maximum Power Transfer Theorems.

REFERENCE BOOKS

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, Asia Publishing House, 1971.
2. Engineering Practical Physics, S. Panigrahi and B. Mallick, Cengage Learning India Pvt. Ltd, 2015.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, Kitab Mahal, 11th Ed. 2011.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: OCSE-102A
SUBJECT NAME: Introduction to Programming (Lab)
NO OF CREDITS: 2

		Internal Assessment:	35
L	**P**	End Semester:	15
0	2	Total:	50

Introduction to Programming Lab

1. Write a program to print "HELLO"
2. Write a program to add two numbers.
3. Write a program to calculate simple interest.
4. Write a program to calculate absolute value of a number.
5. Write a program to swap the values of two numbers.
6. Write a program to find gross salary of a person.
7. Write a program to check if a number is even or odd.
8. Write a program to find greatest of three numbers.
9. Write a program to find grade of a student given his marks.
10. Write a program to find divisor or factorial of a given number.
11. Write a program to print the Fibonacci series.
12. Write a program to print first ten natural numbers.
13. Write a program to print the reverse of a number.
14. Write a program to print the multiplication table of a given number.
15. Write a program to find grade of a list of students given their marks.
16. Write a program using function power (a, b) to calculate the value of a raised to b.
17. Write a program to print a 1-D array of 10 numbers in reverse order.
18. Create Matrix class. Write a menu-driven program to perform following Matrix operations (2-D array implementation):
    a) Sum
    b) Difference
    c) Product
    d) Transpose
19. Write a program to calculate the length of a string.
20. Write a program to copy the contents of one file into another.

B.Sc. (H) MATHEMATICS
SEMESTER-I
CODE: OCHE-102A
SUBJECT NAME: Inorganic Chemistry Lab
NO. OF CREDITS: 2

L	T	P		
			SESSIONAL	: 15
			FINAL EXAM	: 35
0	0	4	TOTAL	: 50

The students have to perform at least 6 experiments from the following

1. Preparations: (Any three)
   Preparation of Cuprous chloride, tetra ammine cupric sulphate, chrome alum, potassium trioxalatochromate(III), Nickel Dimethylglyoxime

2. Volumetric Analysis
   - Preparation of reference solutions.
   - Redox titrations: Determination of Fe^{2+} , $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
   - Iodometric titrations: Determination of Cu^{2+} (using standard hypo solution).
   - Complexometric titrations: Determination of Mg^{2+} , Zn^{2+} by EDTA.

3. Colorimetry
   To verify Beer - Lambert law for $KMnO_4$ /$K_2Cr_2O_7$ and determine the concentration of the given $KMnO_4$ /$K_2Cr_2O_7$ solution.

4. Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Cu(II) and Cd(II)

REFERENCE BOOKS

1. J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.17
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Syllabus of B.Sc. (Hons.) Mathematics

Semester II

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: BMH-201A
SUBJECT NAME: Real Analysis

NO. OF CREDITS: 6

L	T	P
5	1	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
Students will be able to

CO1: Explore many properties of the real line R and learn to define sequence in terms of functions from R to a subset of R.
CO2: Recognize bounded, convergent sequences and monotone sequences.
CO3: Recognize divergent criterion, subsequences, Limit inferior and limit superior of sequences.
CO4: Apply the ratio test, alternating series and limit comparison test for convergence and absolute convergence of an infinite series of real numbers.

UNIT-I
Algebraic and Order Properties of R, Absolute value of a real number, bounded above and bounded below sets, Supremum and infimum of a non-empty subsets of R, The Completeness Property of R, Archimedean property, Density of a rational numbers in R, Definition and types of intervals, Nested interval property, Delta-neighborhood of a point in R. Open, Closed and perfect sets in R, connected subsets of R, Cantor set and Cantor function.

UNIT-II
Sequences of real numbers, Convergent sequences, Bounded Sequences, Limit theorems, Monotone sequences, Monotone convergence theorem.

UNIT-III
Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Limit Superior and Limit inferior. Cauchy sequences, Cauchy's convergence criterion.

UNIT-IV
Introduction to Infinite series, Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy's criterion, Test for convergence of positive term series, The nth term test, Basic Comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's nth root test, integral test, Alternating series, Leibnitz test, Absolute and conditional convergence.

TEXT BOOKS

1. Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis*, 3rd edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. S. C. Malik and Savita Arora, *Mathematical Analysis*, New Age Publications.

REFERENCE BOOKS

1. Gerald G. Bilodeau , Paul R. Thie, Gerard E. Keough, *An Introduction to Analysis*, 2nd edition, Jones & Bartlett, 2010.
2. Brian S. Thomson, Andrew M. Bruckner and Judith B. Bruckner, *Elementary Real Analysis*, Prentice Hall, 2001.
3. Sterling K. Berberian, *A First Course in Real Analysis*, Springer Verlag, New York,1994.
4. T.M. Apostol, *Mathematical Analysis: A Modern Approach to Advanced Calculus*, Pearson Education, 2008.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Real Analysis (BMH-201A)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	3	2	2	2	2	3	3	3
CO2	3	3	3	3	3	3	2	2	2	3	2	3	3	3
CO3	3	3	3	2	3	3	3	3	2	3	2	3	2	3
CO4	3	3	2	3	2	2	2	3	2	3	2	3	2	2
Average	3	3	2.7	2.5	2.7	2.5	2.5	2.5	2	2.7	2	3	2.5	2.7

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: BMH-202A
SUBJECT NAME: Differential Equations

NO. OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

The course will enable the students to

CO1: Explore the genesis of ordinary differential equations.

CO2: Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.

CO3: Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

CO4: Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.

Unit-I: First Order Differential Equations:
Basic concepts of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.

Unit-II: Second Order Linear Differential Equations:
Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients.

Unit-III: Higher Order Linear Differential Equations:
Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.

Unit-IV: Applications:
Orthogonal trajectories, Acceleration-velocity model, Minimum velocity of escape from Earth's gravitational field, Growth and decay models, Radioactive decay, Drug assimilation into the blood of a single cold pill; Free and forced mechanical oscillations of a spring suspended vertically carrying a mass at its lowest Volterra population model, Phenomena of resonance, LCR circuits, Lotka - Volterra population model.

TEXT BOOKS

1. Shepley L. Ross, *Differential Equations*, 3rd edition, 2007, Wiley India.
2. M. D. Raisinghania, *Advanced Differential Equations*, S. Chand Publications.

REFERNCE BOOKS

1. Belinda Barnes and Glenn R. Fulford, *Mathematical Modeling with Case Studies: A Differential Equation Approach Using Maple and MATLAB*, 2nd edition, Chapman & Hall/CRC Press, Taylor & Francis,2015.
2. Herbert I. Freedman, *Deterministic Mathematical Models in Population Ecology*, Marcel Dekker Inc.,1980.
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley,2011.
4. Daniel A. Murray, *Introductory Course in Differential Equations*, Orient,2003.
5. B. Rai, D. P. Choudhury and Herbert I. Freedman, *A Course in Ordinary Differential Equations*, 2nd edition, Narosa,2013.
6. George F. Simmons, *Differential Equations with Applications and Historical Notes*, 3rd edition, CRC Press, Taylor & Francis, 2017.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Differential Equations (BMH-202A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	3	2	3	2	3
CO2	3	3	2	3	2	2	2	2	3	3	3	3	3	2
CO3	3	2	3	3	2	2	2	2	3	3	3	3	2	2

CO4	3	3	3	3	2	2	2	2	3	3	2	2	2	2
Average	3	2.5	2.5	2.8	2	2	2	2	3	3	2.5	2.7	2.3	2.3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER -II
CODE: BMH-203A
SUBJECT NAME: Differential Equations Lab

NO. OF CREDITS: 2

L	T	P
0	0	4

Internal Assessment: 15
End Semester: 35
Total: 50

List of practical (using any software):

1. Solution of first order differential Equation.
2. Plotting of second order solution family of differential equation.
3. Plotting of third order solution family of differential equation.
4. Solution of differential equation by variation of parameter method.
5. Solution of system of ordinary differential equations.
6. Growth model (exponential case only).
7. Decay model (exponential case only).
8. Lake pollution model (with constant/seasonal flow and pollution concentration).
9. Limited growth of population (with and without harvesting).
10. Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.

TEXT BOOKS

1. Belinda Barnes and Glenn R. Fulford, *Mathematical Modelling with Case Studies*, 3rd Edition, CRC Press, 2016.

REFERENCE BOOKS

1. Cesar P. Lopez, *Matlab Differential Equations*, Apress, Springer, 2014.
2. M. Tremont, Solving Odes in Matlab, 2009, http://web.mit.edu/voigtlab/BP205/Notes/BP205_Matlab_slides.pdf.

Ability Enhancement Compulsory Course (AECC)
B.Sc. (H) MATHEMATICS
SEMESTER- II
CODE: BEVS-101A
SUBJECT NAME: Environmental Science
NO OF CREDITS: 2

L	T	P		
			Internal Assessment:	15
			End Semester:	35
2	0	0	Total:	50

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

UNIT -I
Introduction to environmental studies:

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

UNIT -II
Ecosystems:

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT -III
Natural Resources: Renewable and Non-renewable Resources

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

UNIT-IV

Biodiversity and Conservation:

- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

UNIT V

Environmental Pollution:

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

UNIT VI

Environmental Policies & Practices:

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

UNIT VII

Human Communities and the Environment:

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

UNIT VIII

Field work:

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.

- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.

REFERENCE BOOKS

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

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: OPHY-201A
SUBJECT NAME: Fundamentals of Mechanics
NO OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
After the completion of the course, students will be able to,

CO1: Have knowledge of fundamentals of Mechanics
CO2: Have an understanding of rotational dynamics
CO3: Explore the laws of gravitation and central force motion
CO4: Know relative variation of length, mass and time with the velocity of an event
CO5: Analyze elasticity and various elastic parameters

UNIT-I
Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

Ordinary Differential Equations: 1^{st} order homogeneous differential equations. 2^{nd} order homogeneous differential equations with constant coefficients.
Momentum and Energy**:** Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

UNIT-II
Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.
Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.

UNIT-III
Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only).Satellite in circular orbit and applications.
Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

UNIT-IV

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia - Y, η and K by Searles method.

Speed Theory of Relativity**:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

Note: *Students are not familiar with vector calculus. Hence, all examples involve differentiation either in one dimension or with respect to the radial coordinate.*

REFERENCE BOOKS

1. University Physics. FW Sears,MW Zemansky & HD Young 13/e, Addison-Wesley,1986.
2. Mechanics Berkeley Physics course, v.1:Charles Kittel, et.al. 2007, Tata McGraw-Hill
3. Physics – Resnick, Halliday & Walker 9/e, Wiley, 2010.
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., Oxford University Press, 2015.
5. University Physics, Ronald Lane Reese, Thomson Brooks/Cole, 2003.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: OCSC-201A
SUBJECT NAME: Introduction to Database System
NO OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
The students will be able to

CO1: Explore the basic concepts, applications and architecture of database systems
CO2: Master the basics of ER diagram
CO3: Know relational database algebra expressions and construct queries using SQL
CO4: Analyze sound design principles for logical design of databases, normalization

UNIT-I
Database: Introduction to database, relational data model, DBMS architecture, data independence, DBA, database users, end users, front end tools.

UNIT-II
Modeling: Entity types, entity set, attribute and key, relationships, relation types, E- R diagrams, database design using ER diagrams.

UNIT-III
Relational Data Model**:** Relational model concepts, relational constraints, primary and foreign key, normalization: 1NF, 2NF, 3NF.

UNIT-IV
Structured Query Language: SQL queries, create a database table, create relationships between database tables, modify and manage tables, queries, forms, reports, modify, filter and view data.

REFERENCE BOOKS

1. Fundamentals of Database Systems by R. Elmasri and S.B. Navathe, 3rd edition, Addision- Wesley, Low Priced Edition,2000.
2. An Introduction to Database Systems by C.J. Date, 7th edition, Addison-Wesley, Low Priced Edition, 2000.
3. Database Management and Design by G.W. Hansen and J.V. Hansen, 2nd edition, Prentice- Hall of India, Eastern Economy Edition,1999.
4. Database Management Systems by A.K. Majumdar and P. Bhattacharyya, 5th edition,Tata McGraw-Hill Publishing. , 1999.
5. A Guide to the SQL Standard, Date, C. and Darwen,H. 3rd edition, Reading, MA:, Addison- Wesley,1994.
6. Data Management & file Structure by Loomis, PHI, 1989.
7. P. Rob, C. Coronel, Database System Concepts by, Cengage Learning India, 2008.
8. R. Elmsasri,S. Navathe Fundamentals of Database Systems, Pearson Education, Fifth Edition, 2007.
9. MySQL : Reference Manual.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: OCHE-201A
SUBJECT NAME: Physical Chemistry
NO OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
After the successful completion of the course the learner would be able to

CO1: Explore the basic concept chemical thermodynamics
CO2: Analyze chemical ionic equilibrium
CO3: Know phase equilibrium
CO4: Explore electrochemistry

UNIT-I
Chemical Energetics
Review of thermodynamics and the Laws of Thermodynamics.
Important principles and definitions of thermochemistry.Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

UNIT-II
Chemical Equilibrim:
Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between *G* and *G*o, Le Chatelier's principle. Relationships between*Kp, Kc* and *Kx* for reactions involving ideal gases.

Ionic Equilibria:
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

UNIT-III

Solutions:

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium:

Phases, components and degrees of freedom of a system, criteria of phase equilibrium.Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius–Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K only).

UNIT-IV

Electrochemistry:

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: *G*, *H* and *S* from EMFdata. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

REFERENCE BOOKS

1. G. M. Barrow: *Physical Chemistry* Tata McGraw Hill, 2007.
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa, 2004.
3. J. C. Kotz, P. M. Treichel& J. R. Townsend: *General Chemistry* CengageLening India Pvt. Ltd., New Delhi, 2009.
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa, 1998.
5. R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York, 1985.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: OPHY-202A
SUBJECT NAME: Mechanics (Lab)
NO OF CREDITS: 2

L	P		
0	4	Internal Assessment:	35
		End Semester:	15
		Total:	50

At least 5 experiments from the following:

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g.

REFERENCE BOOKS

1. Advanced Practical Physics for students, B.L.Flint and H.T. Worsnop, Asia Publishing House, 1971.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, Kitab Mahal, New Delhi, 2011.
3. Engineering Practical Physics, S. Panigrahi and B.Mallick, Cengage Learning India Pvt. Ltd., 2015.

Open Elective Paper
B.Sc. (H) MATHEMATICS
SEMESTER-II
CODE: OCSC-202A
SUBJECT NAME: Introduction to Database System (Lab)
NO OF CREDITS: 2

		Internal Assessment: 35
L	P	End Semester: 15
0	4	Total: 50

1. Create a database having two tables with the specified fields, to computerize a library system of a Delhi University College.
   LibraryBooks (Accession number, Title, Author, Department, PurchaseDate, Price)
   IssuedBooks (Accession number, Borrower)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) Delete the record of book titled "Database System Concepts".
c) Change the Department of the book titled "Discrete Maths" to "CS".
d) List all books that belong to "CS" department.
e) List all books that belong to "CS" department and are written by author "Navathe".
f) List all computer (Department="CS") that have been issued.
g) List all books which have a price less than 500 or purchased between "01/01/1999" and "01/01/2004".

2. Create a database having three tables to store the details of students of Computer Department in your college.
   Personal information about Student (College roll number, Name of student, Date of birth, Address, Marks (rounded off to whole number) in percentage at 10 + 2, Phone Number)
   Paper Details (Paper code, Name of the Paper)
   Student's Academic and Attendance details (College roll number, Paper code, Attendance, Marks in home examination).

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) Design a query that will return the records (from the second table) along with the name of student from the first table, related to students who have more than 75% attendance and more than 60% marks in paper 2.
c) List all students who live in "Delhi" and have marks greater than 60 in paper1.
d) Find the total attendance and total marks obtained by each student.
e) List the name of student who has got the highest marks in paper2.

3. Create the following tables and answer the queries given below:
   Customer (CustID, email, Name, Phone, ReferrerID)
   Bicycle (BicycleID, DatePurchased, Color, CustID, ModelNo)
   BicycleModel (ModelNo, Manufacturer, Style)
   Service (StartDate, BicycleID, EndDate)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.

b) List all the customers who have the bicycles manufactured by manufacturer "Honda".
c) List the bicycles purchased by the customers who have been referred by customer "C1".
d) List the manufacturer of red colored bicycles.
e) List the models of the bicycles given for service.

4. Create the following tables, enter at least 5 records in each table and answer the queries given below.
   EMPLOYEE (Person_Name, Street, City)
   WORKS (Person_Name, Company_Name, Salary)
   COMPANY (Company_Name, City)
   MANAGES (Person_Name, Manager_Name)

a) Identify primary and foreign keys.
b) Alter table employee, add a column "email" of type varchar(20).
c) Find the name of all managers who work for both Samba Bank and NCB Bank.
d) Find the names, street address and cities of residence and salary of all employees who work for "Samba Bank" and earn more than $10,000.
e) Find the names of all employees who live in the same city as the company for which they work.
f) Find the highest salary, lowest salary and average salary paid by each company.
g) Find the sum of salary and number of employees in each company.h) Find the name of the company that pays highest salary.

5. Create the following tables, enter at least 5 records in each table and answer the queries given below.
   Suppliers (SNo, Sname, Status, SCity) Parts
   (PNo, Pname, Colour, Weight, City)
   Project (JNo, Jname, Jcity)
   Shipment (Sno, Pno, Jno, Qunatity)

a) Identify primary and foreign keys.
b) Get supplier numbers for suppliers in Paris with status>20.
c) Get suppliers details for suppliers who supply part P2. Display the supplier list in increasing order of supplier numbers.
d) Get suppliers names for suppliers who do not supply part P2.
e) For each shipment get full shipment details, including total shipment weights.
f) Get all the shipments where the quantity is in the range 300 to 750 inclusive.
g) Get part nos. for parts that either weigh more than 16 pounds or are supplied by suppliers S2, or both.
h) Get the names of cities that store more than five red parts.
i) Get full details of parts supplied by a supplier in London.
j) Get part numbers for part supplied by a supplier in London to a project in London.
k) Get the total number of project supplied by a supplier (say, S1).
l) Get the total quantity of a part (say, P1) supplied by a supplier (say, S1).

SUBJECT NAME: PHYSICAL CHEMISTRY LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	4	TOTAL	: 50

The students have to perform at least 6 experiments from the following

1. Determination of enthalpy of ionization of ethanoic acid.
2. Determination of enthalpy of hydration of salt.
3. Study of solubility of benzoic acid in water and determine enthalpy change.
4. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
5. Determination of surface tension and viscosity.
6. Potentiometry- Determination of redox potential.
7. Determination of EMF using Potentiometry.
8. Determination of cell constant and conductance of solution.
9. Determination of integral enthalpy (endothermic or exothermic) solution of salt.
10. Synthesis of polymer.

REFERENCE BOOKS

1. G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007).
2. G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
3. J. C. Kotz, P. M. Treichel& J. R. Townsend: General Chemistry CengageLening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
5. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

Syllabus of B.Sc. (Hons.) Mathematics

Semester III

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-III
CODE: BMH-301A
SUBJECT NAME: Probability and Statistics
NO OF CREDITS: 6

L T P	Internal Assessment:	25
5 1 0	End Semester:	75
	Total:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

This course will enable the students to:

CO1: Explore distributions in the study of the joint behaviour of two random variables.

CO2: Formulate and analyze mathematical and statistical problems based on central tendency

CO3: Establish a formulation helping to predict one variable in terms of the other that is, correlation and linear regression

CO4: Acquire mathematical and statistical knowledge of various distributions like Binomial, Poisson and Normal

Unit-I

Probability Functions and Moment Generating Function**:** Basic notions of probability, Conditional probability and independence, Baye's theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Mathematical expectation, Moments, Moment generating function, Cumulative generating function.

Unit-II

Univariate Discrete and Continuous Distributions**:** Bernoulli, Binomial, Poisson, Uniform, Exponential, Normal distribution and their properties.

Unit-III

Bivariate Distribution**:** Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Bivariate normal distribution.

Unit-IV

Linear Correlation and Regression**:** Correlation coefficient, Covariance Calculation of covariance from joint moment generating function, Independent random variables, linear regression for two variables, Rank correlation, Angle between two regression lines, the method of least squares.

TEXT BOOKS

1. Irwin Miller &Marylees Miller, John E. Freund's Mathematical Statistics with Applications (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India,2014.
2. Gupta S.C. and Kapoor V.K., Fundamentals ofMathematical Statistics, S. Chand Pub., New Delhi.,1970.

REFERENCE BOOKS

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig ,Introduction to Mathematical Statistics ,7th edition, Pearson Education, 2013.
2. Jim Pitman, Probability, Springer-Verlag, 1993.
3. Sheldon M. Ross, Introduction to Probability Models ,11th edition, Elsevier, 1993.
4. A. M. Yaglom and I. M. Yaglom, Probability and Information. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1993.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Probability and Statistics (BMH-301A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	3	2	3	2	3
CO2	3	3	2	3	2	3	2	2	3	3	3	3	3	2
CO3	3	3	3	2	2	2	2	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	2	2	3	3	2	3	2	3
Average	3	2.75	2.5	2.5	2	2.25	2	2	2.75	3	2.5	3	2.3	2.7

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-III
CODE: BMH-302A
SUBJECT NAME: **Group Theory**
NO OF CREDITS: 6

L	T	P
5	1	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

Students will be able to

CO1: Explore the basic concepts of groups and their elementary properties
CO2: To know about subgroups, centralizer, normalizar and cyclic groups
CO3: Analyze the idea of cosets and their properties, Cauchy's theorem, Lagranges theorem
CO4: Have understanding of Group homomorphisms and isomorphism theorems and to know about External and Internal direct products and Class equations

Unit-I
Groups, Subgroups and its Elementary Properties
Definition and examples of group, Elementary properties of groups, Symmetries of a square, Dihedral groups, Subgroups and examples of subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups

Unit-II
Cyclic Groups, Permutation Groups and Lagrange's Theorem
Properties of cyclic groups, Classification of subgroups of cyclic groups, Cycle notation for permutations, Properties of permutations, Even and odd permutations, Alternating groups; Properties of cosets, Lagrange's theorem; Normal subgroups, Factor groups and their applications.

Unit-III
Group Homomorphisms
Cauchy's theorem for finite abelian groups, Group homomorphisms, Properties of homomorphisms, Group isomorphisms, Cayley's theorem, Properties of isomorphisms, First, Second and Third isomorphism theorems for groups.

Unit-IV

Class Equation, External and Internal Direct Products of Groups
Commutator subgroup and its properties; External direct products of groups and its properties, Internal direct products, Conjugacy classes, Class equation and their applications.

TEXT BOOKS

1. Joseph A. Gallian, Contemporary Abstract Algebra Narosa Publishing House, New Delhi, 4th Edition, 1999.(IX Edition 2010).
2. I.N. Herstein, Abstract Algebra ,3rd Edition, Wiley Publication,1996.

REFERENCE BOOKS

1. Joseph J. Rotman, An Introduction to the Theory of Groups, Springer Verlag, 4th Edition, 1995.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Group Theory (BMH-302A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	3	2	3	2	3
CO2	3	3	2	3	2	3	2	2	3	3	3	3	3	2
CO3	3	3	3	3	2	3	2	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	2	2	3	3	2	3	2	3
Average	3	2.75	2.5	2.75	2	2.75	2	2	2.75	3	2.5	3	2.3	2.7

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER- III
CODE: BMH-303A
SUBJECT NAME: **Multivariate Calculus**
NO OF CREDITS: 4

L	T	P
4	0	0

Internal Assessment:	25
End Semester:	75
Total:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Check continuity of functions of two variables

CO2: Evaluate partial derivatives, directional derivatives, extremum values of functions of two variable

CO3: Evaluate area and volume as double and triple integrals

CO4: Visualize vector fields and evaluate line integrals and to evaluate integrals using Green's theorem, Divergence theorem and Stokes theorem

UNIT – I

Functions of several variables, domain and range, level curves and contour lines, limit and continuity of functions of two variables. Partial differentiation, total differentiability, sufficient condition for differentiability, chain rules, implicit differentiation.

UNIT – II

Directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes and normal lines. Extremum points and saddle points, extremum values of functions of two variables, method of Lagrange multipliers, constrained optimization problems.

UNIT – III

Double integration over rectangular region, double integration over non-rectangular region, Area between two curves, change of order of integration, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, Change of variable in double integrals and triple integrals, Polar, cylindrical and spherical co-ordinates.

UNIT – IV

Vector fields, divergence, curl and their physical interpretation, curves in space, velocity vector and tangent vector, Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path, Statement and applications of Green‟s theorem, Divergence theorem, Stoke‟s theorem.

TEXT BOOKS

1. G. B. Thomas and R.L. Finney. *Calculus*. 9th Ed., Delhi: Pearson Education, 2005.
2. T. M. Apostol. Calculus-I and Calculus-II, 2nd Ed., John Wiley & Sons, New Delhi, 2011.

REFERENCE BOOKS

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

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Multivariate Calculus (BMH-303A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	3	2	3	2	3
CO2	3	3	2	3	2	3	2	2	3	3	3	3	3	2
CO3	3	3	3	2	2	2	2	2	2	3	3	3	2	3
CO4	3	3	3	3	3	3	2	2	2	3	2	3	2	3
Average	3	2.75	2.5	2.5	2.75	2.75	2	2	2.25	3	2.5	3	2.3	2.7

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-III
CODE: BMH-304A
SUBJECT NAME: Multivariate Calculus (LAB)
NO OF CREDITS: 4

L	T	P
0	0	4

Internal Assessment:	15
End Semester:	35
Total:	50

List of programs using MATLAB

1. Revisiting plotting of graphs in 2D.
2. Drawing Surfaces: Planes, Intersection of planes
3. Visualizing Paraboloids, intersection of a paraboloid and plane
4. Drawing sphere, ellipsoids and their intersection with planes.
5. Drawing different surfaces find level curves at the given heights.
6. Drawing contour lines at different heights corresponding to different surfaces.
7. Revising limits of single variables
8. Finding limits for functions of two variables.
9. Discuss the limit of different functions when n tends to infinity
10. Discuss the limit of different functions when n tends to 0
11. Visualizing saddle points on different surfaces
12. Draw the tangent plane to different surfaces at the given point.
13. Find critical points and identify relative maxima, relative minima or saddle points to given surfaces, if it exists.
14. Locating points of relative & absolute extremum for different functions

TEXT BOOKS

1. R. Pratap, *Getting Started with MATLAB*, Oxford University Press, New Delhi, 2015.
2. S.J. Chapman, *MATLAB Programming for Engineers*, 4th Edition, Cengage Learning, Boston, USA, 2015.

REFERENCE BOOKS

1. S. N. Alam and S. S. Alam, *Understanding MATLAB: A Textbook for Beginners*, I K International Pub., 2013.
2. P. Dechaumphai, *Calculus and Differential Equations with MATLAB,* Narosa Publications, 2013.

Skill Enhancement Course (SEC)
B.Sc. (H) MATHMATICS
SEMESTER-III
CODE: SEC-301A
SUBJECT NAME: Latex
NO. OF CREDITS – 2

L T P	Internal Assessment: 25
2 0 0	End Semester: 75
	Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

Students will be able to

CO1: Create and Typeset a LaTeX document
CO2: Typeset a mathematical document
CO3: Draw pictures in LaTeX
CO4: Create Beamer Presentations

UNIT-I

Getting Started With Latex : Introduction to TeX and LaTeX, Creating and typesetting a simple LaTeX document, Adding basic information to documents, Environments, Footnotes, Sectioning, Displayed material.

UNIT-II

Mathematical Type setting : Accents and symbols; Mathematical typesetting (elementary and advanced): Subscript/ Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Putting one thing above another, Spacing and changing style in math mode; Page Layout ;Titles, Abstract Chapters, Sections, References, Equation references, citation. List making environments Table of contents, Figure handling, numbering, List of figures, List of tables, Generating index.

UNIT-III

Graphics and PSTricks : Pictures and graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions.

UNIT-IV

Getting Started with Beamer : Beamer, Frames, Setting up beamer document, Enhancing beamer presentation.

REFERENCE BOOKS

1. Dick Oliver, Teach Yourself HTML 4 in 24 Hours, Techmedia, 2002.
2. Craig Zacker: 10 Minutes Guide to HTML, Style sheets, PHI, 1997.
3. Martin J. Erickson and Donald Bindner, A Student's Guide to the Study,Practice, and Tools of Modern Mathematics, CRC Press,2010.
4. Stefan Kottwitz, Latex Beginners Guide, Packt Publishing, 2011.
5. Lamport, Leslie, LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint, 1994.

Skill Enhancement Course (SEC)
B.Sc. (H) MATHMATICS
SEMESTER-III
CODE: SEC-302A
SUBJECT NAME: French-I
NO. OF CREDITS – 2

L	T	P
2	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

Each lesson is divided into three parts which consist of Dialogue, Vocabulary and Grammar. There will be periodical test & written examination at the end of each semester. There will also be a viva-voice
Examination at the end of semester.
Students are expected to pass the viva-voice separately to qualify for the exam.

Description du materiel

1objectifscommunicatifs

- S'initiera'la culture francaise
- De'crire line personne
- Dire la nationalite'
- Parler des saisons
- Localizer des objects
- Demander l donner des goûts et des préférences

2Grammaire/ vocabulaire

- Les verbes en(er)
- Les pronomssujels
- Les articles definis
- Le corps humain
- Les verbes en(ir)
- Les articles inde'finis
- La negation
- Les verbes en (ger)
- Le fe'minim et le pluriel
- Les expressions avec faire
- Les (nombres) (1-100)
- Les prepositions
- L'interrogations
- Les verbs en (re) et irreguliers
- Les repasfrancais
- Les adjectifspossessifs
- De'crireuneville

REFERENCE BOOKS

1) APPRENONS LE FRANCAIS Methode de Francais by MahithaRanjit , Monica Singh
b) LE NOUVEAU SANS FRONTIERESMethode de Francais by Philippe Domonique, Jacky Girardet.
2) Took reference from Bhartia VidyaBhawaninstitute of foreign languages.

Skill Enhancement Course (SEC)
B.Sc. (H) MATHEMATICS
SEMESTER-III
CODE: SEC-303A
SUBJECT NAME: German-I
NO. OF CREDITS – 2

L T P
2 0 0

Internal Assessment: 25
End Semester: 75
Total: 100

UNIT-1	• Introduction • Basic Greetings in German
UNIT-2	• Counting 1-100 • Basic questions in German • Introduce yourself
UNIT-3	• Personal Pronouns • Verb conjugations (regular verbs)
UNIT-4	• Articles- der, die, das • Vocabulary (classroom objects with articles)
UNIT-5	• Days, months, seasons + im/am • Time (formal & informal) • Counting 1000+
UNIT-6	• Verb Conjugations (Irregular verbs) • Separable Verbs

REFERENCE BOOKS

1. Netzwerk A1 by Paul Rusch
2. Studio d A1 by Funk, Kuhn, Demme

Skill Enhancement Course (SEC)
B.Sc. (H) MATHMATICS
SEMESTER-III
CODE: SEC-304A
SUBJECT NAME: Elementary Statistical Techniques
NO. OF CREDITS – 2

L	T	P
2	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
After the completion of the course, students will be able to,

CO1: Analyze and develop the integrity, reasoning process in inferential statistics using the
CO2: concept of probability
CO3: Analyze and develop the integrity, meaning and mechanics of the hypothesis testing reasoning process in inferential statistics using the techniques of descriptive statistics
CO4: Know about concept of sampling
CO5: Explore concept of central tendency of statistical data

UNIT-I.
Types of data, Primary data, Secondary data, Cross-sectional data, time series data, failure data, industrial data, directional data. Notion of a statistical population: Finite population, infinite population, homogeneous population and heterogeneous population. Notion of sample, random sample and non-random sample. Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRWOR) stratified random sampling, systematic sampling, cluster sampling and two-stage sampling.

UNIT -II.
Classification: Raw data and its classification, Discrete frequency distribution, Sturge's rule, continuous frequency distribution, inclusive and exclusive methods of classification, Open end classes, cumulative frequency distribution and relative frequency distribution. Graphical Presentation of Data: Histogram, frequency curve, frequency polygon, Ogive curves, stem and leaf chart. Check sheet, Parato diagram. Examples and Problems.

UNIT -III.
Concept of central tendency of statistical data: Statistical average, characteristics of a good statistical average. Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmetic mean, Mode: Definition, formula for computation (with derivation) graphical method of determination of mode, merits and demerits. Median: Definition, formula for computation (with derivation) graphical method of determination of median, merits and demerits. Empirical relation between mean, median and mode. Partition Values: Quartiles, Deciles and Percentiles.

UNIT -IV.

Concept of dispersion, characteristics of good measure of dispersion. Range: Definition, merits and demerits. Mean square deviation, Variance and standard deviation : Definition, merits and demerits, effect of change of origin and scale. Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation.

REFERENCE BOOKS

1. A.M. Goon, M.K. Gupta and Das Gupta: Fundamentals of Statistics, Vol. 1, The World Press Pvt. Ltd., Kolkata, 1966.
2. Mukhopadhyay, P. : Mathematical Statistics, New Central Book Agency, Calcutta,1996.
3. Introduction to Mathematical Statistics, Ed. 4 , MacMillan Publishing Co. New York, 1989.
4. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 1970.

Open Elective Course (OEC-3)
B.Sc. (H) MATHEMATICS
SEMESTER-III
CODE: OCSC-301A
SUBJECT NAME: Computer Network & Internet Technology
NO. OF CREDITS – 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of the course, the student will be :

CO1: Acquainted with the concepts of Computer Networks, Its topologies and various communication Models

CO2: Able to use internet terminologies like searching fundamentals and its types on internet, Telnet, Email, Chat Servers, FTP and Net Meeting etc. in order to solve problems

CO3: Able to develop a web page by using various tags and concepts of Hyper Text Markup Language

UNIT -I

Computer Networks: Uses of Computer Network, Network Hardware, Network Software, Goals and Applications of Computer networks, Structure of Computer Network: Point-to-point structure, Broadcasting structure.

UNIT -II

Types of Networks, Topologies. Reference Models: OSI Reference Model, TCP/IP reference Model, Comparison of OSI and TCP Reference Model. Data Communication: Transmission media, Wireless communication, and the Telephone system, Introduction to cellular radio and communication satellite, Data Rate of Channel, Electromagnetic spectrum.

UNIT-III

World Wide Web : Introduction, Miscellaneous Web Browser details, searching the www: Directories search engines and meta search engines, search fundamentals, search strategies, working of the search engines, Telnet and FTP, E Mail, Chat Servers, net meeting, video conferencing.

UNIT-IV

Hypertext markup language: The anatomy of an HTML document: Marking up for structure and style: basic page markup, absolute and relative links, ordered and unordered lists, embedding images and controlling appearance, table creation and use, frames, nesting and targeting.

REFERENCE BOOKS

1. Computer Networks (3rd edition), Tanenbaum Andrew S., International edition, 1996.
2. Forouzan, Data Communications and Networking, TMH, 4 th Edition, 2006.
3. William Stallings, Data and Computer Communications, PHI, 7th Edition, 2003
4. Fundamentals of the Internet and the World Wide Web, Raymond Greenlaw and Ellen Hepp 2001, TMH
5. Internet &World Wide Programming, Deitel, Deitel& Nieto, Pearson Education, 2000.
6. Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, Addison Wesley, Low Price Edition, 2000.

Open Elective Course (OEC-3)
B.Sc.(H) MATHEMATICS
SEMESTER-III
CODE: OPHY-301A
SUBJECT NAME: Fundamentals of Waves & Optics
NO. OF CREDITS – 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of the course, students will be able to,

CO1: Evaluate the superposition of linear and perpendicular oscillations.
CO2: Learn the basics of wave motion and SHM.
CO3: Analyze interference phenomena in various systems.
CO4: Know the phenomenon of Diffraction of light in various systems.

UNIT-I

Superposition of Two Collinear Harmonic oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle.(1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and theiruses.

UNIT-II

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

Sound: Sound waves, production and properties. Intensity and loudness of sound. Decibels. Intensity levels,musical notes. musical scale. Acoustics of buildings (General idea).

UNIT-III

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

Interference**:** Interference: Division of amplitude and division of wave front. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment.

Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger

Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

Michelson's Interferometer**:** Construction and working. Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility offringes.

UNIT-IV

Diffraction: Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.
Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

REFERENCE BOOKS:

1. Fundamentals of Optics, F.A Jenkins and H.E White, McGraw-Hill, 1976.
2. Principles of Optics, B.K. Mathur, Gopal Printing, 1995.
3. Fundamentals of Optics,A. Kumar, H.R. Gulati and D.R. Khanna, R. Chand Publications, 2011.
4. University Physics.F.W. Sears, M.W. Zemansky and H.D. Young.13/e,1986.
5. Addison-Wesley Series.

Open Elective Course (OEC-3)
B.Sc. (H) MATHEMATICS
SEMESTER-III
CODE: OCHE-301A
SUBJECT NAME: Organic Chemistry
NO. OF CREDITS – 4

L	T	P
4	0	0

Internal Assessment: 25
End Semester: 75
Total: 100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the successful completion of the course the learner would be able to

CO1: Evaluate the basic concept of organic chemistry.
CO2: Evaluate stereochemistry of organic compounds
CO3: Analyze mechanisms of organic reactions.
CO4: Explore the methods of preparation and reaction of different functional groups in organic chemistry.

UNIT- I

Fundamental of organic chemistry

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and perconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Reaction intermediates: Carbocations, Carbanions and free radicals. Electrophiles and nucleophiles Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Intercon version of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis*- *trans*nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

UNIT- II

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations physical property & chemical reactions) to be studied with mechanism in context to their structure.

Alkanes: *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: *Preparation:* Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) andtrans-addition (bromine), Addition of HX (Markownikoff'sand anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: Preparation: Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.
Reactions: formation of metal acetylides and acidity of alkynes, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4. Hydration to form carbonyl compounds.

UNIT- III

Aromatic hydrocarbons:Preparation (benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.
Reactions: (benzene): Electrophilic substitution reactions:nitration, halogenation sulphonation. Friedel-Craft's reaction (alkylation and acylation) Side chain oxidation of alkyl benzenes.

Alkyl Halides :Preparation: from alkenes and alcohols.
Reactions: Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions, hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer&Gattermann reactions.
Reactions (Chlorobenzene): Aromatic electrophilic and nucleophilic substitution (replacement by – OHgroup) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3).
Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards Nucleophilic substitution reactions. .

UNIT- IV

Alcohols: Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3), factors affecting acidity, Oppeneauer oxidation
Diols: oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and phonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. acidity and factors affecting

Ethers (aliphatic and aromatic).Preparation : Williamson ether synthesis.
Reactions: Cleavage of ethers with HI
Aldehydes and ketones (aliphatic and aromatic):Preparation: from acid chlorides and from nitriles.
Reactions – Nucleophilic addition, Nucleophilic addition – elimination reaction including Reaction with HCN, ROH, NaHSO3, NH2-G derivatives.Iodoform test.Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

REFERENCE BOOKS

1. T. W. Graham Solomons: *Organic Chemistry, John Wiley and Sons, 2015*.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman, 2003.
3. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S, 2002.
4. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall, 2016.
5. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand, 2016.

Open Elective Course (OEC-3)
B.Sc.(H). MATHMATICS
SEMESTER- III
Paper code: OCSC-302A
SUBJECT NAME:: Computer Networks and Internet Technologies (LAB)
NO. OF CREDITS – 2

L	T	P
0	0	4

Internal Assessment: 15
End Semester: 35
Total: 50

Practical exercises based on concepts listed in theory using HTML.

1. Create HTML document with following formatting – Bold, Italics, Underline, Colors, Headings, Title, Font and Font Width, Background, Paragraph, Line Brakes, Horizontal Line, Blinking text as well as marquee text.

2. Create HTML document with Ordered and Unordered lists, Inserting Images, Internal and external linking
3. Create HTML document with Table:

<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td colspan="2" rowspan="3">Some image here</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
</table>

4. Create Form with Input Type, Select and Text Area in HTML.
5. Create an HTML containing Roll No., student's name and Grades in a tabular form.
6. Create an HTML document (having two frames) which will appear as follows:

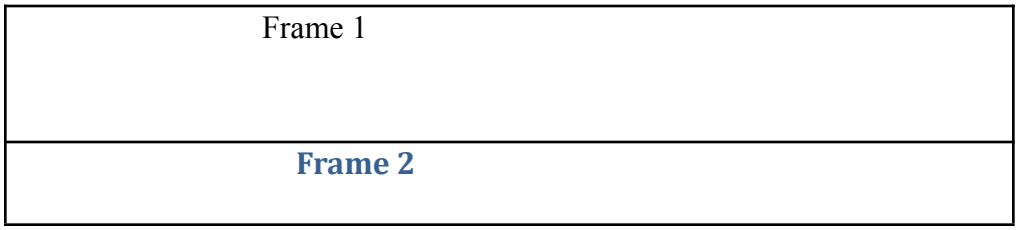
<table>
<tr><td>About
Department 1
Department 2
Department 3</td><td>This frame would show the contents according to the link clicked by the user on the left frame</td></tr>
</table>

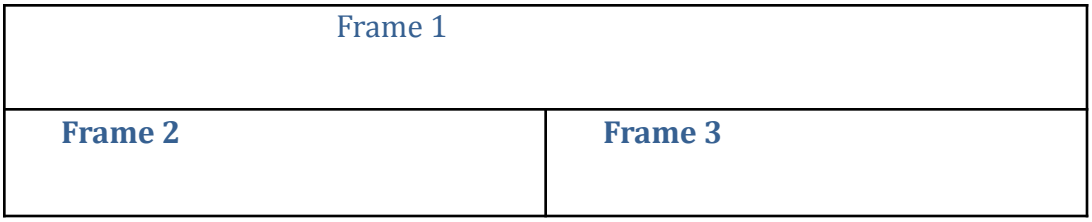
7. Create an HTML document containing horizontal frames as follows:

<table>
<tr><td>Department Names (could be along with Logos)</td></tr>
<tr><td>Contents according to the Link clicked</td></tr>
</table>

8. Create a website of 6 – 7 pages with different effects as mentioned in above problems.

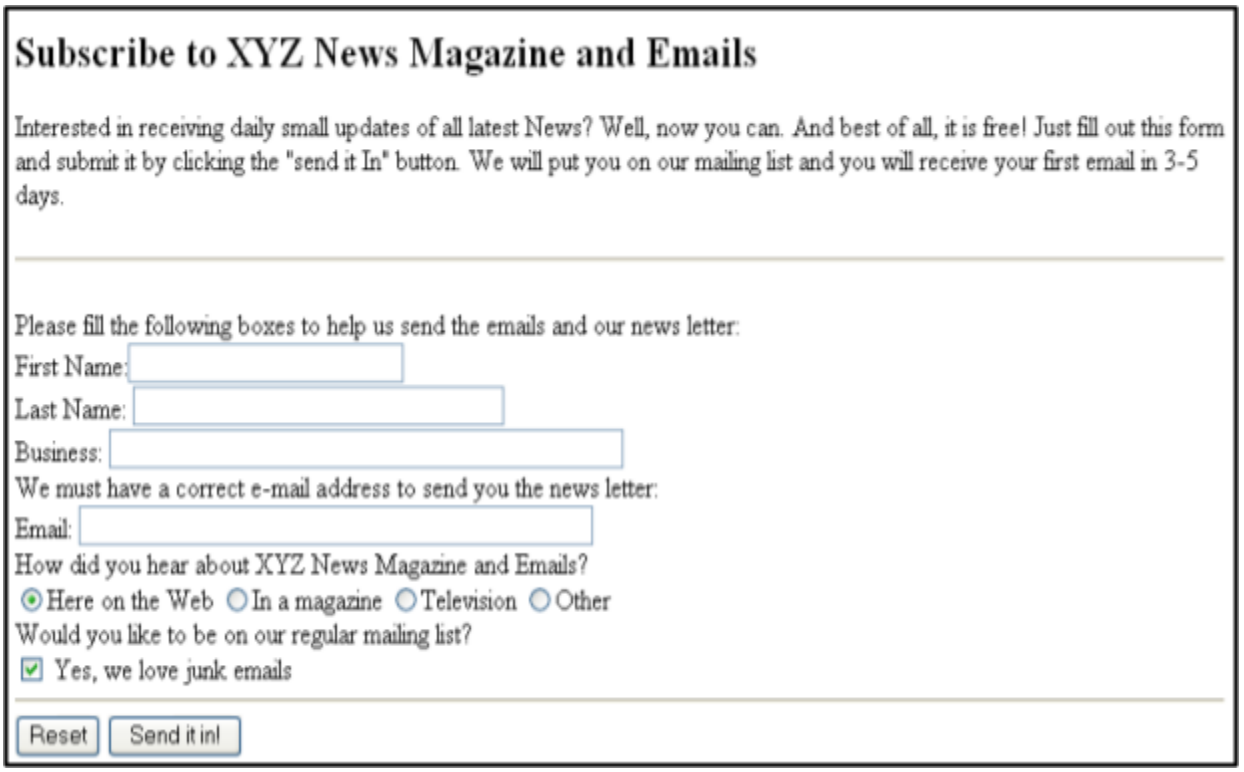
9. Create HTML documents (having multiple frames) in the following formats





10. Create a form using HTML which has the following types of controls:

I. Text Box
II. Option/radio buttons
III. Check boxes
IV. IV. Reset and Submit buttons



List of Practicals using Javascript :

Create event driven program for following:

1. Print a table of numbers from 5 to 15 and their squares and cubes using alert.
2. Print the largest of three numbers.
3. Find the factorial of a number n.
4. Enter a list of positive numbers terminated by Zero. Find the sum and average of these numbers.
5. A person deposits Rs 1000 in a fixed account yielding 5% interest. Compute the amount in the account at the end of each year for n years.
6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the List.

Open Elective Course (OEC-3)
B.Sc. (H). MATHMATICS
SEMESTER-III
CODE: OPHY-302A
SUBJECT NAME: Waves & Optics (LAB)
NO. OF CREDITS – 2

L	T	P
0	0	4

Internal Assessment: 15
End Semester: 35
Total: 50

AT LEAST FIVE EXPERIMENTS FROM THE FOLLOWING

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Refractive Index of the Material of a Prism using Sodium Light.
6. To determine Dispersive Power of the Material of a Prism using Mercury Light
7. To determine the value of Cauchy Constants.
8. To determine the Resolving Power of a Prism.
9. To determine wavelength of sodium light using Fresnel Biprism.
10. To determine wavelength of sodium light using Newton's Rings.
11. To determine the wavelength of Laser light using Diffraction of Single Slit.
12. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating
13. To determine the Resolving Power of a Plane Diffraction Grating.
14. To determine the wavelength of laser light using diffraction grating.

REFRENCE BOOKS

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

Open Elective Course (OEC-3)
B.Sc. (H). MATHMATICS
SEMESTER-III
CODE: OCHE-302A
SUBJECT NAME: Organic Chemistry (LAB)
NO. OF CREDITS – 2

L	T	P
0	0	4

Internal Assessment: 15
End Semester: 35
Total: 50

The students have to perform at least 6 experiments from the following

1. Qualitative analysis of unknown organic compounds containing aryl halides.
2. Qualitative analysis of unknown organic compounds containing aromatic hydrocarbons.
3. Qualitative analysis of unknown organic compounds containing alcohols.
4. Qualitative analysis of unknown organic compounds containing aldehydes.
5. Qualitative analysis of unknown organic compounds containing ketones.
6. Qualitative analysis of unknown organic compounds containing phenols.
7. Oxidation of ethanol/isopropanol (Iodoform reaction).
8. Aldol condensation using either conventional or green methods.
9. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone and benzaldehyde.
10. Acylation of phenols.

REFERENCE BOOKS:

1. T. W. Graham Solomons: *Organic Chemistry, John Wiley and Sons*.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
3. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
5. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand.

Syllabus of B.Sc. (Hons.) Mathematics

Semester IV

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: BMH-401A
SUBJECT NAME: Analytical Geometry
NO OF CREDITS: 6

L	T	P
5	1	0

INTERNAL ASSESSMENT: 25
END SEMESTER: 75
TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

This course will enable the students to:

CO1: Know about the classification of general equations of second degree
CO2: Familiarize with polar equations of conic, chord, tangent
CO3: Recognize equations of sphere, cone, cylinder, enveloping cone, enveloping cylinder
CO4: Explain the properties of three dimensional shapes and reduce general equation of second degree into canonical form

UNIT – I

System of conics, General equation of second degree. Tangent and normal to the conic, Chord of contact, Pole and polar with respect to a conic, director circle of conic, Polar equation of a conic, Polar equation of chord of contact and tangent and normal to the conic.

UNIT – II

Sphere, Plane section of a sphere, Sphere through a given circle. Intersection of two spheres, Radical plane of two spheres, Cones, Right circular cone and reciprocal cone. Cylinder, Right circular cylinder.

UNIT – III

Central Conicoids, Equation of tangent plane, condition of tangency, Normal to the conicoids, Plane of contact and polar plane of a conicoid., Enveloping cone, Enveloping cylinder

UNIT – IV

Paraboloids, its shapes, Plane sections of conicoids, Generating lines, Reduction of second degree equations.

TEXT BOOKS

1. P. K. Jain and Khalil Ahmad : A Textbook of Analytical Geometry, New Age International Publishers, 2018.
2. J. G. Chakravorty and P. R. Ghosh : Advanced Analytical Geometry, U. N. Dhur & Sons Pvt. Ltd., 2018.

REFERENCE BOOKS

1. R. J. T. Bell, Elementary Treatise on Coordinary Geometry of Three Dimensions, MacMillan India Ltd., 1994.
2. D. Chatterjee, Analytical Geometry: Two and Three Dimensions, Narosa Publishing House, 2009.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Analytical Geometry (BMH-401A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	2	3	3	3	2
CO2	3	2	3	3	2	3	3	3	3	2	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	2	3	3	2	3
Average	3	2	3	3	2	3	3	3	3	2	3	3	2.5	2.67

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: BMH-402A
SUBJECT NAME: Ring Theory & Linear Algebra
NO OF CREDITS: 6

INTERNAL ASSESSMENT:	25
END SEMESTER:	75
TOTAL:	100

L T P
5 1 0

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

Students will have the knowledge of

CO1: Rings, Subrings, Ideals and Fields
CO2: Ring Homomorphism and Isomorphism Theorems
CO3: Vector Space, Subspace, Span and Quotient Space
CO4: Linearly independent and dependent vectors, Linear Transformation and properties and isomorphism of linear transformations

UNIT – I

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

UNIT – II

Ring Homomorphism, properties of ring Homomorphism, Isomorphism theorems I, II and III, field of quotients.

UNIT – III

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear dependence and linear independence, basis and Standard basis, dimension of a vector space, dimension of subspaces.

UNIT – IV

Linear transformation, Properties of linear transformation, algebra of linear transformations, Matrix representation of a linear transformation, Isomorphisms, properties of isomorphism , invertibility.

TEXT BOOKS

1. Joseph A. Gallian, *Contemporary Abstract Algebra* (10th Edition), Narosa Publishing House, New Delhi, 1999.
2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra* (4th Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.

REFERENCE BOOKS

1. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall of India Pvt. Limited, 1971.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Ring Theory and Linear Algebra (BMH-402A)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	2	2	3	3	3	2	3	3	3
CO3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	2	3	2	3	2	3	3	2
Average	3	2.75	3	3	3	2	2.5	3	2.5	3	2.5	3	3	2.75

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: BMH-403A
SUBJECT NAME: Partial Differential Equations
NO OF CREDITS: 4

L T P	INTERNAL ASSESSMENT:	25
4 0 0	END SEMESTER:	75
	TOTAL:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
This course will enable the students to:

CO1: Apply a range of techniques to solve first & second order partial differential equations.
CO2: Solve linear and non-linear partial differential equations using various methods and apply these methods in solving some physical problems
CO3: To classify, hyperbolic, parabolic and elliptic types (linear partial differential equations of second and higher order) and reduction of Canonical (Normal) forms and their solutions
CO4: Model physical phenomena using partial differential equations such as Laplace, heat and wave equations

UNIT – I
Partial differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order: Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. Compatible systems of first order equations, Jacobi's method.

UNIT – II
Linear partial differential equations of second and higher orders, Homogenous and Non-homogenous linear partial differential equations with constant coefficients, Partial differential equations reducible to equations with constant coefficients, their complimentary functions and particular Integrals.

UNIT – III

Classification of linear partial differential equations of second order, Hyperbolic, Parabolic and Elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Monge's method for partial differential equations of second order.

UNIT – IV

Cauchy's problem for second order partial differential equations, Characteristic equations and characteristic curves of second order partial differential equation, Method of separation of variables: Solution of Laplace's equation, Wave equation (one and two dimensions), Diffusion (Heat) equation (one and two dimension) in Cartesian Co-ordinate system.

TEXT BOOKS

1. Ian N.Sneddon: Elements of Partial Differential Equations, McGraw Hill Book Company, 1988.
2. M.D.Raisinghania, Ordinary and Partial Differential Equations, S.Chand Publications(18 th Edition)

REFERENCE BOOKS

1. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967.
2. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999.
3. Frank Ayres: Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Partial Differential Equations (BMH-403A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	2	2	2	2	3
CO2	3	3	2	3	2	2	2	3	3	3	3	3	3	3
CO3	2	2	3	3	3	2	2	2	3	2	3	3	3	2
CO4	3	3	3	3	2	2	2	2	3	2	2	2	2	2
Average	2.7	2.5	2.5	2.8	2.7	2	2	2.7	3	2.3	2.5	2.5	2.5	2.5

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: BMH-404A
SUBJECT NAME: Partial Differential Equations (LAB)
NO OF CREDITS: 2

L	T	P
0	0	4

INTERNAL ASSESSMENT: 15
END SEMESTER: 35
TOTAL: 50

Practical /Lab work to be performed in a Computer Lab:

Modeling of the following similar problems using any software

1. Plot Three Dimensional Graphs
2. Solution of Cauchy problem for first order PDE.
3. Write a program to solve one dimensional parabolic equation.
4. Write a program to solve one dimensional hyperbolic equation.
5. Write a program to solve two dimensional parabolic equation.
6. Write a program to solve two dimensional Elliptic equation.
7. Find the Fourier series of a function
8. Solution of non-linear systems of Partial differential equations.
9. Write a program to solve the heat equation.
10. Write a program to solve the wave equation.

TEXT BOOKS

1. Alexander Stanoyevitch, Introduction to numerical ordinary and Partial Differential Equations using Matlab, Wiley, 2005.
2. P. Howard, Partial Differential Equations in Matlab, pdf, 2010.
3. Jichun Li and Yi-Tung Chen, Computational partial differential equations using MATLAB, CRC Press, 2008.
4. Stojanova A, Zlatanovska B, Kocaleva M, Gicev V., Obtaining functions from fourier series with Matlab, A journal for information Technology, Educational Development and Teaching Methods of Technical and Natural sciences, Vol 5, 2015.
5. Mathew P. Coleman, An introduction to partial differential equations with MATLAB, 2013.

REFERENCE BOOKS

1. Pratap, Rudra. Getting Started with MATLAB 5-A Quick Introduction for Scientists and Engineers. 1998.

Skill Enhancement Course (SEC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: SEC-401A
SUBJECT NAME: Seminar
NO OF CREDITS: 2

L	T	P
2	0	0

INTERNAL ASSESSMENT: 25
END SEMESTER: 75
TOTAL: 100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

A student will be required to present two seminars, one during ongoing semester of 25 marks and other at the end of semester of 75 marks.
The evaluation of the semester end seminar will be done by a departmental committee consisting of three faculty members to be constituted by chairperson.

Skill Enhancement Course (SEC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: SEC-402A
SUBJECT NAME: French II
NO OF CREDITS: 2

L T P	INTERNAL ASSESSMENT:	25
2 0 0	END SEMESTER:	75
	TOTAL:	100

Each lesson is divided into three parts whichconsist of Dialogue, Vocabulary and Grammar.
There will be periodical test & written examination at the end of each semester. There will also be a viva-voice examination at the end of semester.
Students are expected to pass the viva-voice separately to qualify for the exam.

Description du materiel

1 objectifs communicatifs

- S'initier a'la culture francaise
- Salut
- Parler dela quantite
- Decrire une personne
- Parler de la famille
- Decrire la journee
- Dire l'heure
- Parler des saisons
- Interroger sur/ Parler de la Sante

2 Grammaire/ vocabulaire

- Les verbes en(er, ir, re)
- La negation
- Les articles
- Les adverbes de quantite
- Le feminin et le pluriel des noms et des adjectifs
- La position des adjectifs
- L'infinitif apres un autre verb

- Les membres de la famille
- Les verbes pronominaux
- Les nombres cardinaux et ordinaux
- Les saisons, les jours de la semaine et les mois de l'annee
- Trois formes d'interrogation
- L'interrogation negative et (si)
- Les expressions avec (avoir)
- Les animaux
- Les couleurs

REFERENCE BOOKS

1. (a) APPRENONS LE FRANCAIS Methode de Francais by Mahitha Ranjit , Monica Singh
(b) LE NOUVEAU SANS FRONTIERES Methode de Francais by Philippe Domonique, Jacky Girardet
2. Took reference from Bhartia Vidya Bhawan institute of foreign languages.

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Skill Enhancement Course (SEC)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: SEC-403A
SUBJECT NAME: German II
NO OF CREDITS: 2

INTERNAL ASSESSMENT: 25
L T P END SEMESTER: 75
2 0 0 TOTAL: 100

UNIT-1	• Hobbies • Professions
UNIT-2	• Family • Possesive pronouns and articles
UNIT-3	• Nominative and Accusative case • Definite and indefinite articles in German
UNIT-4	• Articles- der, die, das • Vocabulary (classroom objects with articles)
UNIT-5	• Modal Verbs • Imperative
UNIT-6	• W-questions • Introduction

REFERENCE BOOKS

1. Netzwerk A1 by Paul Rusch
2. Studio d A1 by Funk, Kuhn, Demme

Both the books are used at Goethe Institut (Max Mueller Bhavan), New Delhi for teaching German as a foreign language.

Skill Enhancement Course (SEC)
B.Sc. (H).MATHMATICS
SEMESTER-IV
CODE: SEC-404A
SUBJECT NAME: Basics of Operating System
NO. OF CREDITS – 2

L	T	P
2	0	0

INTERNAL ASSESSMENT: 25
END SEMESTER: 75
TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
Students will be able to

CO1: Know about Processes, Threads and Scheduling algorithms
CO2: Explore the principles of concurrency and Deadlocks
CO3: Analyze various memory management schemes
CO4: Evaluate the basics of Linux system and perform administrative tasks on Linux Servers

UNIT -I
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

UNIT- II
Processes-Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads-Overview, Multicore Programming, Multithreading Models; Windows 7 – Thread and SMP Management. Process Synchronization – Critical Section Problem, Mutex Locks, Semophores, Monitors; CPU Scheduling and Deadlocks.

UNIT- III
Main Memory-Contiguous Memory Allocation, Segmentation, Paging, 32 and 64 bit architecture Examples; Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

UNIT- IV

Linux System- Basic Concepts;System Administration-Requirements for Linux System Administrator, Setting up a LINUX Multifunction Server, Domain Name System, Setting Up Local Network Services; Virtualization- Basic Concepts, Setting Up Xen,VMware on Linux Host and Adding Guest OS.

REFERENCE BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc., 2012.
2. William Stallings, “Operating Systems – Internals and Design Principles”, 7th Edition, Prentice Hall, 2011.
3. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Addison Wesley, 2001.

Open Elective Course (OEC-4)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: OCSC-401A
SUBJECT NAME: Information Security
NO. OF CREDITS: 4

L	T	P
4	0	0

INTERNAL ASSESSMENT: 25
END SEMESTER: 75
TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
After the successful completion of the course, the student will be able to :

CO1: Explore the basics of Information Security
CO2: Become acquainted with various types of cryptographic techniques and ciphers
CO3: Have an insight of various security threats in network and email in particular
CO4: Become familiar with the security aspects needed in management and get acquainted with the recent trends and challenges of information security

UNIT-I
Information Security Basics
Introduction to Information Security: Attacks, Vulnerability, Security Goals, Security Services and mechanisms. Classification of Attacks, Introduction to "What is Infosphere", Difference between Information Security, Computer Security and Cyber Security.

Unit-II
Conventional Cryptographic Techniques
Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher**;** Symmetric and Asymmetric Cryptographic Techniques: DES, RSA algorithms, Authentication and Digital Signatures: Use of Cryptography for authentication, Secure Hash function, Key management – Kerberos.

Unit-III
Security in Networks
Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Firewalls – Design and Types of Firewalls, Personal Firewalls, IDS, Email Security – PGP,S/MIME.

Unit-IV
Information Security in Management
System Administration policies, Security audit, Penetration testing and ethical hacking, Mandatory Access control, Discretionary Access Control, Monitoring and logging tools, Legal aspects. Current trends and challenges in Information Security.

REFERENCE BOOKS

1. William Stalling, Cryptography and Network Security, 3rd Edition,PHI New Delhi,2018.
2. William Stalling, Network Security Essentials, 2nd Edition,PHI New Delhi,2017.
3. Charles P. Pfleeger, Security in computing, 4th Edition Pearson,New Delhi,2018.

Open Elective Course (OEC-4)
B.Sc. (H) MATHEMATICS
SEMESTER-IV
CODE: OPHY-401A
SUBJECT NAME: Fundamentals of Nuclear and Particle Physics
NO. OF CREDITS – 6

L	T	P
5	1	0

INTERNAL ASSESSMENT: 25
END SEMESTER: 75
TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of the course, students will be able to,

CO1: Explore the basic nuclear properties and the basic nuclear models
CO2: Evaluate the radioactivity process and nuclear reactions and fission, fusion processes
CO3: Analyze how nuclear radiations interact with matter
CO4: Analyze how nuclear radiations are detected physics of various detectors
CO5: Know the basic nuclear particle's conservation laws and quark model

UNIT-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

UNIT-II

Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) -decay: energy kinematics for -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission and kinematics, internal conversion.

Nuclear Reactions**:** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound & direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

UNIT-III

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube. Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

UNIT-IV

Particle Accelerators: Accelerator facility available in India:Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

Particle physics**:** Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model.

REFERENCE BOOKS

1. Introductory nuclear Physics by Kenneth S.Krane ,Wiley India Pvt. Ltd., 2008.
2. Concepts of nuclear physics by Bernard L.Cohen,Tata Mcgraw Hill,1998.
3. Introduction to the physics of nuclei &particles, R.A.Dunlap, Thomson Asia, 2004.
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons, 2008.
5. Radiation detection and measurement, G.F. Knoll John Wiley & Sons, 2000.

Open Elective Course (OEC-4)
B.Sc. (H) MATHMATICS
SEMESTER- IV
CODE: OCSC-402A
SUBJECT NAME: Information Security (LAB)
NO. OF CREDITS – 2

INTERNAL ASSESSMENT: 15
L T P END SEMESTER: 35
0 0 4 TOTAL: 50

S.NO	Name of the Practical
1	Implement Caesar Cipher in 'C'
2	Implement Playfair Cipher with Key enetered by User in 'C'
3	Implement Polyalphabetic Cipher in 'C'
4	Implement simple Columnar Transposition Technique in 'C'
5	Implement Simple RSA Algorithm with small numbers in 'C'
6	Implement Simplified DES in 'C'
7	Generation of keys in DES Algorithm in 'C'
8	Implement Vignere cipher in 'C'
9	Implement Hill Cipher in 'C'
10	Implement Vernam Cipher in 'C'
11	Implementation of Cryptoanalysis of Monoalphabetic Cipher in 'C'
12	Implementation of Cryptoanalysis of Polyalphabetic Cipher in 'C'

Syllabus of B.Sc. (Hons.) Mathematics

Semester V

Discipline Core Course (DCC)

B.Sc. (H) MATHEMATICS
SEMESTER-V
CODE: BMH-501A
SUBJECT NAME: Mechanics-I
NO OF CREDITS: 6

L T P	INTERNAL ASSESSMENT:	25
5 1 0	END SEMESTER:	75
	TOTAL:	100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Know about the concept of composition and resolution of force
CO2: Evaluate moments and couples
CO3: Analyze concepts of Velocity and Acceleration
CO4: Know about motion of two bodies connected by a string and describe the Simple Harmonic Motion

UNIT – I

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

UNIT – II

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

UNIT –III

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

UNIT –IV

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

TEXT BOOKS

1. S. L. Loney, *The elements of statics and dynamics*, 5th edition, Cambridge Statics, 1947.
2. E.W. Nelson, C.L. Best, W.G. Mclean, *Schaum's outline of theory and problems of engineering mechanics-statics and dynamics*, 5th edition, Mc Graw Hill Book Company, New Delhi, 1997.

REFERENCE BOOKS

1. Andrew Pyte and Jaan Kiusalaas, *Engineering Mechanics: Statics*, 4th edition, Cengage Learning, Lib Wright Publisher, 2016.
2. J. L. Synge and B.A. Griffth, *Principles of mechanics*, 2nd edition, Mc-Graw Hill Book Company, 1947.
3. A. S. Ramsey, *Statics: A text-book for the use of the higher divisions in schools and for first year students at the universities*, Cambridge University Press, 1934.
4. A. S. Ramsey, *Dynamics: A text-book for the use of the higher divisions in schools and for first year students at the universities*, Cambridge University Press, 1929.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Mechanics-I (BMH-501A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	2	2	2	2	3
CO2	3	3	2	3	2	2	2	3	3	3	3	3	3	3
CO3	2	2	3	3	3	3	2	3	3	2	3	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	2	2
Average	2.7	2.5	2.5	2.8	2.7	2.75	2	2.25	2.75	2.3	2.5	2.5	2.5	2.5

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER V
CODE: BMH-502A
SUBJECT NAME: Numerical Methods
NO OF CREDITS: 4

	Internal Assessment:	25
L T P	End Semester:	75
4 0 0	Total:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

On successful complete of this course, the students should be able to:

CO1: Evaluate Newton‘s interpolation, Central difference interpolation formula
CO2: Explore Gauss interpolation formulae, Langrage’s interpolation formula and Newton‘s divided Difference formulae.
CO3: Know about the solution of algebraic and transcendental equations
CO4: Find the solution of simultaneous algebraic equations and to evaluate the solution of Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Weddle and Boole’s formula.

UNIT-I

Errors in Numerical calculations: Introduction, Numbers and their accuracy, Absolute, relative and percentage errors.
Solution of Algebraic And Transcendental Equations: Bisection method, method of false position, secant method, iteration method, Newton's Raphson method. Order of convergence of the above methods.

UNIT-II

Finite Differences And Interpolation: Various difference operators and relation between them, Newton‘s forward and backward interpolation formulae. Central difference interpolation formula. Gauss forward and backward interpolation formulae. Langrage’s interpolation formula and Newton‘s divided difference formulae.

UNIT-III

Solutions of Simultaneous Algebraic Equations: Gauss Elimination method, Gauss-Jorden method, LU Decomposition, Crout method, Relaxation method, Jacobi's method, Gauss-Seidel method.

UNIT-IV

Numerical Differentiation and Integration: Formula for derivatives, Newton's forward interpolation formula, Newton's backward difference formula, Newton cotes quadrature, Trapezoidal rule, Simpson's 1/3rd and 3/8th rules. Boole's & Weddle rule, Gauss quadrature formula.

TEXT BOOKS

1. B.S. Grewal, Numerical Methods in Engg. & Science, Khanna Publications, 2013.
2. S.S. Shastri, Introduction Methods of Numerical Analysis, PHI learning pvt. limited.

REFERENCE BOOKS

1. C.E. Froberg, Introduction to Numerical Analysis, Addison Wesly publication company, 1970.
2. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, 2006.
3. C. F. Gerald & P. O. Wheatley, Applied Numerical Analysis, Pearson Education, 2008.
4. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engg. Computations,Wiley Eastern Ltd.
5. R.S. Gupta, Element of Numerical Analysis, Macmillon's India, 2010.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Numerical Methods (BMH-502A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	2	2	2	2	3
CO2	3	3	2	3	2	2	2	3	3	3	3	3	3	3
CO3	2	2	3	3	3	3	2	3	3	2	3	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	2	2

Average	2.7	2.5	2.5	2.8	2.7	2.75	2	2.25	2.75	2.3	2.5	2.5	2.5	2.5

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course(DCC)
B.Sc. (H) MATHEMATICS
SEMESTER V
CODE: BMH-503A
SUBJECT NAME: Numerical Methods

(LAB)

NO OF CREDITS: 4

INTERNAL ASSESSMENT: 15
END SEMESTER: 35
TOTAL: 50

L T P
0 0 4

PRACTICALS:

1. Write a program for Newton‘s forward interpolation formulae
2. Write a program for Newton‘s backward interpolation formulae
3. Write a program for Gauss forward interpolation formulae.
4. Write a program for Gauss backward interpolation formulae.
5. Write a program for Langrage’s interpolation formula
6. W.A.P for Newton ‘s divided difference formulae
7. W.A.P to solve the equation using Bisection method
8. W.A.P to solve the equation using method of false position
9. W.A.P to solve the equation using secant method
10. W.A.P to solve the equation using iteration method
11. W.A.P to solve the equation using Newton's Raphson method
12. W.A.P to find the solutions of Simultaneous Algebric Equations using Jacobi's method,
13. W.A.P to find the solutions of Simultaneous Algebric Equations using Gauss-Seidal method.
14. W.A.P to evaluate the integral using Trapezoidal rule,
15. W.A.P to evaluate the integral Simpson's $1/3^{rd}$
16. W.A.P to evaluate the integral using Simpson’s $3/8^{th}$ rules

Discipline Elective Course.
(DEC)
B.Sc. (H) MATHEMATICS
SEMESTER-V
CODE: DEMH-501A
SUBJECT NAME: Discrete Mathematics
NO OF CREDITS: 6

INTERNAL ASSESSMENT: 25
L T P END SEMESTER: 75
5 1 0 TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Analyze algebra of sets and partially ordered sets
CO2: Recognize recurrence relations and their solutions
CO3: Know propositions, quantifiers and basics of graph theory
CO4: Explore lattices, properties of lattices and Boolean algebra

UNIT – I

Sets, algebra of sets, Representation of relations on finite set, Mappings, Composition of Mappings, Countability of sets, partially ordered sets, Hasse diagram, Isomorphic ordered sets, Hashing function, Principle of Mathematical Induction.

UNIT-II

Recurrence Relations, Explicit formula for a sequence, solution of Recurrence Relations, Homogeneous Recurrence Relations with constant coefficients, Particular solution of a Difference Equation, Recursive functions, generating functions, Convolution of Numeric functions, Solution of Recurrence Relation by the method of Generating functions

UNIT-III

Propositions, Basic Logical Operations, Logical Equivalence involving Tautologies and Contradictions, conditional propositions, Quantifier. Universal Modus Ponens, Universal Modes Tollens, Use of diagrams for validity of arguments. Definition of Graphs, Paths, Circuits, cycles and subgraphs, degree of a vertex, connectivity, Planar graphs and their properties.

UNIT-IV

Lattice, Properties of lattice, lattice as algebraic system, lattice isomorphism, Bounded, complemented and distributive lattice. Introduction of Boolean Algebra, Boolean algebra as lattices, Boolean forms and their equivalence, Minterm Boolean forms, Sum of products canonical forms, minimization of Boolean functions

TEXT BOOKS

1. Babu Ram, Discrete Mathematics, Pearson Publications.
2. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill. 1985.

REFERENCE BOOKS

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 2002.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (3rd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2018.
3. Rudolf Lidl and Günter Pilz, Applied Abstract Algebra (2nd Edition), Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 1998.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Discrete Mathematics (DEMH-501A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	3
CO2	2	2	3	3	3	3	3	3	2	3	2	3	3	2
CO3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO4	2	3	2	3	3	3	3	3	2	3	3	2	3	2
Average	2.5	2.7	2.5	3	2.7	3	2.7	3	2	3	2.7	2.5	3	2.5

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course(DEC)
B.Sc. (H). MATHEMATICS
SEMESTER V
CODE: DEMH-502A
SUBJECT NAME: Mathematical Modeling
NO OF CREDITS: 6

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
5 1 0	TOTAL: 100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
Students will be able to

CO1: Describe the concept of Differential Equations
CO2: Know construction of Mathematical models through difference equations
CO3: Have knowledge of Mathematical models through different graphs
CO4: Know about the construction of Mathematical models through linear programming

UNIT – I
Simple situations requiring mathematical modeling, techniques of mathematical modeling, Classifications, Characteristics and limitations of mathematical models, Some simple illustrations.

UNIT - II
Mathematical modeling through differential equations, linear growth and decay models, Nonlinear growth and decay models, Compartment models, Mathematical modeling in dynamics through ordinary differential equations of first order.

UNIT - III
Mathematical models through difference equations, some simple models, Basic theory of linear difference equations with constant coefficients, Mathematical modeling through difference equations in economic, finance, population dynamics and genetics.

UNIT - IV
Situations that can be modeled through graphs. Mathematical models in terms of Directed graphs, in terms of signed graphs and in terms of weighted digraphs. Mathematical modeling through linear programming.

TEXT BOOKS

1. J. N. Kapur, Mathematical Modeling, New age international publishers, 2015.

REFERENCE BOOKS

1. F. Charlton, Ordinary Differential and Difference Equations, Van Nostrand, 1965.
2. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equation for Scientists and Engineers, Springer, Indian reprint, 2006.
3. Frank R. Giordano, Maurice D. Weir and William P. Fox, A First Course in Mathematical Modeling, Thomson Learning, London and New York, 2003.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Mathematical Modeling (DEMH-502A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	3
CO2	2	2	3	3	3	3	3	3	2	3	2	3	3	2
CO3	3	3	3	3	3	3	3	3	3	2	3	2	3	3
CO4	2	3	2	3	3	2	3	3	2	3	3	2	3	3
Average	2.5	2.7	2.5	3	2.7	2.75	2.7	3	2.25	2.75	2.7	2.5	3	2.75

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course (DEC) B.Sc.
(H) MATHEMATICS
SEMESTER V
CODE: DEMH-503A
SUBJECT NAME: Special Functions And Integral Transform NO OF CREDITS: 6

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
5 1 0	TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

This course will enable the students to:

- CO1: Describe the concept of Legendre and Hermite differential equations, Recurrence relation, and integral representation of lender polynomial
- CO2: Learn Power series method, Bessel's equations, term by term differentiation and integration of Bessel's functions
- CO3: Know about piecewise continuous functions, Dirac delta function, Laplace transforms and its properties, apart from it, Solve ordinary differential equations using Laplace transforms
- CO4: Familiarize with Fourier transforms of functions, Explain Parseval's identity, applications of Fourier transform to boundary value problems

UNIT – I

Series solution of differential equations – Power series method, Bessel equation and its
Series solution of differential equations – Power series method, Bessel equation and its solution: Bessel functions and their properties-Convergence, Recurrence Relations and generating functions, Orthogonality of Bessel functions, Integral representation of Bessel functions.

UNIT – II

Legendre and Hermite differentials equations and their solutions: Legendre and Hermite functions and their properties-Recurrence Relations and generating functions. Orthogonality of Legendre and Hermite polynomials. Rodrigue's Formula for Legendre & Hermite Polynomials, Laplace Integral Representation of Legendre polynomial.

UNIT – III

Laplace Transforms: Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Laplace transforms of derivatives and integrals, Inverse Laplace transforms, convolution theorem, Inverse Laplace transforms of derivatives and integrals, solution of ordinary differential equations using Laplace transforms.

UNIT – IV

Fourier Transforms: Linearity property, Shifting, Modulation, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Convolution Theorem, Parseval's identity for Fourier transforms, solution of differential Equations using Fourier Transforms.

TEXT BOOKS

1. I.N. Sneddon : Special Functions on mathematics, Physics & Chemistry,1966.
2. I.N. Sneddon: the use of integral *transforms*, McGraw Hill, 1972.

REFERENCE BOOKS

1. Lokenath Debnath and Dambaru Bhatta. Integral transforms and their applications, Taylor and Francis group, 2015.
2. Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999.
3. A.R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd, 2005.
4. W.W. Bell : Special Functions for Scientists & Engineers, 2004
5. Murray R. Spiegel Laplace transform, Schaum's Series,1965

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Special Functions and Integral Transforms (DEMH-503A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	3	3	3	2	3	2	3
CO2	3	3	2	3	2	2	2	3	3	3	3	2	3	2
CO3	3	2	3	3	3	3	2	3	3	3	3	3	2	3
CO4	3	3	3	3	2	2	2	3	3	3	2	2	3	2
Average	3	2.5	2.5	2.8	2.3	2.3	2	3	3	3	2.5	2.3	2.5	2.5

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course(DEC)
B.Sc. (H) MATHEMATICS
SEMESTER- V
CODE: DEMH- 504A
SUBJECT NAME: Application Of Algebra And Graph Theory
NO OF CREDITS: 6

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
5 1 0	TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
Students will be able to

CO1: Describe the concept of Graph Theory
CO2: Explore different Type of Matrices
CO3: Have knowledge of trees
CO4: Learn Application of Matrices

UNIT –I
Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices. Frobenius- König theorem, Birkhoff theorem. Positive Semi-definite matrices: positive semi-definite matrices, square root of a positive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization.

UNIT –II
Symmetric matrices : diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and Statistics.

UNIT – III
Graph Theory Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

UNIT –IV
Directed Graphs, Trees, Isomorphism of Trees, Representation of Algebraic Expressions by Binary Trees, Spanning Tree of a Graph, Shortest Path Problem, Minimal spanning Trees, Cut Sets and Tree Searching.

REFERENCE BOOKS

1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
2. David C. Lay, Linear Algebra and its Applications. 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. C.L. Liu, Elements of Discrete Mathematics: A computer oriented approach, McGraw-Hilll Book Co. 5,2017.
4. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.
5. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

Discipline Elective Course (DEC) B.Sc. (H)
MATHEMATICS
SEMESTER V
CODE: DEMH-505A
SUBJECT NAME: Linear Programming
NO OF CREDITS: 6

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
5 1 0	TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

This course will enable the students to:

CO1: Analyze and solve linear programming models of real-life situations
CO2: Provide graphical solutions of linear programming problems with two variables
CO3: Understand the theory of the simplex method
CO4: Know about the relationships between the primal and dual problems, and to understand sensitivity analysis and learn about the applications to transportation, assignment and two-person zero-sum game problems

UNIT – I

Formulation**,** Canonical and standard forms, Graphical method Basic solutions, Basic Feasible solutions, Reduction of feasible solution to basic feasible solution, Correspondence between basic feasible solutions and extreme points.

UNIT – II

Optimality criterion, Improving a basic feasible solution, Unboundedness, Unique and alternate optimal solutions; Simplex algorithm, Artificial variables, Two-phase method, Big-*M* method.

UNIT-III

Formulation of the dual problem, Duality theorems, Complimentary slackness theorem, Dual-simplex method.

UNIT – IV

Transportation Problem: Definition and formulation, Methods of finding initial basic feasible solutions: Northwest-corner rule, Least- cost method, Vogel approximation method; Algorithm for obtaining optimal solution.
Assignment Problem: Mathematical formulation and Hungarian method.
Game Theory: Formulation and solution of two-person zero-sum games, Games with mixed strategies, Linear programming method for solving a game.

TEXT BOOKS:

1. Hamdy A. Taha, *Operations Research*: *An Introduction,*10th edition, Pearson,2017.
2. Gupta, P.K. and Hira, D.S., *Operations Research*, S. Chand & Co.
3. Sharma, S.D., *Operation Research*, Kedar Nath Ram Nath Publications.

REFERENCE BOOKS

1. G. Hadley, *Linear Programming*, Narosa Publishing House, 2002.
2. Frederick S. Hillier & Gerald J. Lieberman, *Introduction to Operations Research,* McGraw-Hill Education, 10th edition, 2015.
3. Paul R. Thie & Gerard E. Keough , *An Introduction to Linear Programming and Game Theory,* Wiley India Pvt. Ltd, 3rd edition, 2014.
4. Mokhtar S. Bazaraa, John J. Jarvis & Hanif D. Sherali , *Linear Programming and Network Flows, John* Wiley & Sons, 4th edition, 2010.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, p point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Linear Programming (DEMH-505A)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	3
CO2	2	2	3	3	3	3	3	3	2	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO4	2	3	2	3	3	3	3	3	2	3	3	2	2	2
Average	2.5	2.7	2.5	3	2.7	3	2.7	3	2.25	3	2.7	2.5	2.75	2.75

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Syllabus of B.Sc. (Hons.) Mathematics

Semester V

Syllabus of B.Sc. (Hons.) Mathematics

Semester VI

Discipline Core Course DCC)
B.Sc. (H) MATHEMATICS
SEMESTER VI
CODE: BMH-601A
SUBJECT NAME: Complex Analysis NO OF CREDITS: 4

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
4 0 0	TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

At the end of this course, students will be able to
CO1: Explorecomplex numbers and their properties
CO2: Know about the significance of analytic functions and Cauchy Riemann equations in Cartesian and polar coordinates
CO3: Analyze the role of Cauchy integral formula and Liouville's theorem
CO4: Find residues and apply residue theorem to evaluate integrals

UNIT-I

Complex number system, Algebraic properties, Geometric interpretation, Properties of moduli, Regions in complex plane, Functions of complex variable, Topological aspects of the complex plane-ball, limit, continuity, derivatives, Cauchy sequence and convergence, Stereographic projection.

UNIT-II

Analytic functions, Cauchy-Riemann equations, Sufficient conditions for differentiability, Polar conditions, Harmonic functions, Construction of analytic functions, Exponential function, Logarithmic function, Trigonometric function, Line integral.

UNIT-III

Contours, Contour integral and its examples, Upper bounds for moduli of contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, Derivatives of analytic function, Liouville's theorem and the fundamental theorem of algebra.

UNIT-IV

Taylor and Laurent series, Absolute and uniform convergence of power series, Zeros of analytic functions, Isolated singular points, Types of isolated singular points, Residues, Residue at poles, Residue theorem and its applications to evaluate real definite integral.

TEXT BOOKS

1. Joseph Bak and Donald J. Newman, *Undergraduate text in Mathematics*, *Complex Analysis*, 3rd edition, Springer , 2010.
2. James W. Brown and Ruel V. Churchill , *Complex Variable and Applications*, 9th edition, McGraw Hill Education, New York, 2014.

REFERENCE BOOKS

1. John B. Conway, *Functions of one Complex variable*, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
2. H. A. Priestly, *Introduction to Complex Analysis*, 2nd edition, Oxford University Press, 2003.
3. Lars V. Ahlfors , *Complex Analysis*, 3rd edition, McGraw-Hill Education, , 2017.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Complex Analysis (BMH-601A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	2	3	3	3	2	3	3	3	2
CO3	3	3	3	3	3	3	3	2	2	2	3	3	3	3
CO4	3	3	2	3	3	3	3	3	2	3	3	3	3	2
Average	3	2.75	3	3	2.75	2.5	3	2.75	2.5	2.5	3	3	3	2.5

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Core Course (DCC)
B.Sc. (H) MATHEMATICS
SEMESTER-VI
CODE: BMH-602A
SUBJECT NAME: Set Theory and Metric Space
NO OF CREDITS: 6

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
5 1 0	TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

This course will enable the students to

CO1: Know the basic concepts of set theory
CO2: Have knowledge of Partially ordered sets
CO3: Know the basic concepts of metric spaces
CO4: Analyze some concepts of metric space such as completeness and continuity

UNIT-I

Schröder-Bernstein theorem, Cantor's theorem, Order relation in cardinal numbers, Arithmetic of cardinal numbers, partially ordered set, Zorn's lemma and Axiom of choice, Various set theoretic paradoxes.

UNIT-II

Definition and examples of metric spaces, Open spheres and closed spheres, Neighbourhoods, Open sets, Interior, exterior and boundary points, closed sets, Limit points and isolated points, Interior and closure of a set, Boundary of a set, Bounded sets, Distance between two sets, Diameter of a set, Subspace of a metric space.

UNIT-III

Cauchy and Convergent sequences, Completeness of metric spaces, Cantor's intersection theorem, Dense sets and separable spaces, Nowhere dense sets and Baire's category theorem, Continuous and uniformly continuous functions, Homeomorphism, Banach contraction principle.

UNIT-IV

Compact spaces, Sequential compactness, Bolzano-Weierstrass property, Compactness and finite intersection property, Heine-Borel theorem, Totally bounded sets, Equivalence of compactness and sequential compactness, Continuous functions on compact spaces. Separated sets, Disconnected and connected sets, Components, Connected subsets of $\mathbb{R}$, Continuous functions on connected sets.

TEXT BOOKS

1. Dinesh Bansal, I.S. Gupta, Satbir Mehla and Indu Bala Bansal, Real Analysis, Jeevansons Publications, 2019.
2. Bartle, Robert G. & Sherbert, Donald R., *Introduction to Real Analysis,* Wiley India, 4th Edition, 2015
3. P. R. Halmos, Naive Set Theory. Springer,1974

REFERENCE BOOKS

1. Kumaresan, Somaskandan, *Topology of metric spaces*. Alpha Science Int'l Ltd., 2005.
2. Simmons, George F., *Introduction to Topology and Modern Analysis*, McGraw-Hill Education, New Delhi, 2004.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Set Theory and Metric Space (BMH-602A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	2
CO2	2	2	3	3	3	3	3	3	2	3	2	3	3	2
CO3	3	3	3	3	3	3	3	2	3	2	3	2	3	3
CO4	2	3	2	3	3	3	3	3	2	3	3	2	3	2
Average	2.5	2.7	2.5	3	2.7	3	2.7	2.75	2.25	2.75	2.7	2.5	3	2.25

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

UNIT - IV

Forwards and futures, marking to market, value of a forward/futures contract, replicating portfolios, futures on assets with known income or dividend yield, currency futures, hedging (short, long, cross, rolling), optimal hedge ratio, hedging with stock index futures, interest rate futures, swaps. Lognormal distribution, Lognormal model, Geometric Brownian Motion for stock prices

REFERENCE BOOKS

1. David G. Luenberger, Investment Science, Oxford University Press, Delhi, 1998.
2. John C. Hull, Options, Futures and Other Derivatives (6th Edition), Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, An Elementary Introduction to Mathematical Finance (2nd Edition), Cambridge University Press, USA, 2003.
4. Kevin J Hastings, Introduction to Financial Mathematics , CRC Press,2015.

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Discipline Elective Course (DEC)
B.Sc. (H) MATHEMATICS
SEMESTER VI
CODE: DEMH-602A
SUBJECT NAME: Mechanics-II
NO OF CREDITS: 6

L T P	INTERNAL ASSESSMENT:	25
5 1 0	END SEMESTER:	75
	TOTAL:	100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Understand equilibrium of forces and conditions for equilibrium
CO2: Understand the concept of virtual work, laws of friction and describe center of gravity
CO3: Learn about angular velocity, angular acceleration, centripetal and centrifugal force, planetary motion
CO4: Learn the concept of work, power and energy

UNIT-I

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

UNIT-II

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

UNIT- III

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

UNIT- IV

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

TEXT BOOKS

1. S. L. Loney, *The elements of statics and dynamics*, 5th edition, Cambridge Statics, 1947.
2. E.W. Nelson, C.L. Best, W.G. Mclean, *Schaum's outline of theory and problems of engineering mechanics-statics and dynamics*, 5th edition, Mc Graw Hill Book Company, New Delhi, 1997.

REFERENCE BOOKS

1. Andrew Pyte and Jaan Kiusalaas, *Engineering Mechanics: Statics*, 4th edition, Cengage Learning, Lib Wright Publisher, 2016.
2. J. L. Synge and B.A. Griffth, *Principles of mechanics*, 2nd edition, Mc-Graw Hill Book Company, 1947.
3. F. Chorlton,Text book of Dynamics. CBS Publishers, Reprint 2002.
4. A. S. Ramsey, *Statics: A text-book for the use of the higher divisions in schools and for first year students at the universities*, Cambridge University Press, 1934.
5. A. S. Ramsey, *Dynamics: A text-book for the use of the higher divisions in schools and for first year students at the universities*, Cambridge University Press, 1929.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Mechanics-II (DEMH-602A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	2
CO2	2	2	3	3	3	3	3	3	2	3	3	3	3	2
CO3	2	3	3	3	3	2	2	2	3	2	3	2	2	2
CO4	2	3	2	3	3	2	3	3	3	3	3	2	3	3
Average	2.25	2.7	2.5	3	2.7	2.5	2.5	2.75	2.75	2.75	3	2.5	2.75	2.25

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course
(DEC) B.Sc. (H)
MATHEMATICS
SEMESTER-VI
CODE: DEMH-603A
SUBJECT NAME: Riemann Integral
NO OF CREDITS: 6

L	T	P	INTERNAL ASSESSMENT:	25
5	1	0	END SEMESTER:	75
			TOTAL:	100

NOTE**:** Question paper will have two parts. Part-A is compulsory and contains 10 questions each of1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:
This course will enable the students to:
CO1: Explore basic concepts of Riemann integration
CO2: Implement Fundamental Theorem of integration
CO3: Know about the Improper integral
CO4: Have the knowledge of the convergence of Improper integral

UNIT – I

Partition of a set, Refinement of a Parttition, Inequalities for upper and lower Darboux sums, Upper and lower integral, Necessary and sufficient conditions for the integrability of a function using Darboux sums, Definition of Riemann integration by Riemann sum and equivalence of the two definitions (by Riemamm sum and Darboux sum), Integrability of monotone functions and continuous functions, Properties of Riemann integrable functions with proofs.

UNIT – II

Definitions of piecewise continuous and piecewise monotone functions and integrability, Examples of Riemann and non-Riemann integrable functions. Mean Value theorem (First and second), Primitive of a function, Fundamental theorems (I and II) of calculus and the integration by parts.

UNIT – III

Improper integrals: Type-I, Type-II and mixed type, Comparison Tests for improper integral of type-II and I with proof, Cauchy's Tests.

UNIT – IV

Able's Test, Dirichlet's Test of convergence, Convergence of Beta and Gamma functions, Frullani's Theorem.

TEXT BOOKS

1. Dinesh Bansal, I.S. Gupta, Satbir M ehla and Indu Bala Bansal, Real Analysis, Jeevansons Publications, 2019.
2. Bartle, Robert G. & Sherbert, Donald R., *Introduction to Real Analysis,* Wiley India,4th Edition, 2015

REFERENCE BOOKS

1. Roussos, Ioannis Markos. *Improper Riemann Integrals*. CRC Press, 2013.
2. Bashirov, Agamirza. *Mathematical analysis fundamentals*. Academic Press, 2014.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Riemann Integral (DEMH-603A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	2
CO2	2	2	3	3	3	3	3	3	2	3	2	3	3	2
CO3	3	3	3	3	3	3	2	2	3	2	3	2	2	3
CO4	2	3	2	3	3	3	3	3	3	3	3	2	3	2
Average	2.5	2.7	2.5	3	2.7	3	2.5	2.75	2.75	2.75	2.7	2.5	2.75	2.25

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course (DEC)
B.Sc. (H) MATHEMATICS
SEMESTER-VI
CODE: DEMH-604A
SUBJECT NAME: Number Theory
NO OF CREDITS: 6

L	T	P
5	1	0

INTERNAL ASSESSMENT: 25
END SEMESTER: 75
TOTAL: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

At the end of this course, students will have the knowledge of

CO1: Division Algorithm, GCD and LCM, linear congruences and their properties, Chinese Remainder Theorem.

CO2: Fermat's and Wilson's theorems, Mobius inversion formula and the greatest integer function.

CO3: Euler's phi-function and its properties, Euler's theorem, Primitive roots

CO4: Quadratic residues, quadratic reciprocity and Fermat's Last theorem

UNIT – I

Divisibility and properties, The division algorithm, G.C.D. (Greatest Common Divisors), L.C.M (Least Common Multiple), Prime Numbers, Euclidean Algorithm, Fundamental Theorem of Arithmetic, Congruences and Basic Properties, Linear Diophantine equation, Chinese remainder theorem.

UNIT – II

Fermat's little theorem and applications, Wilson's theorem and applications, Number theoretic functions, sum and number of divisors, perfect numbers, totally multiplicative functions, the Mobius Inversion formula and related results, the greatest integer function and its properties.

UNIT-III

Euler's Phi-function, some properties of Euler's Phi-function, Euler's generalization of Fermat's theorem, reduced set of residues, some properties of Euler's phi-function. Order of an integer modulo n, complete and reduced residue system, primitive roots for primes, composite numbers having primitive roots.

UNIT – IV

Quadratic residues, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, Gauss reciprocity law, quadratic congruences with composite moduli, the equation $x^2 + y^2 = z^2$, Fermat's last theorem

TEXT BOOKS

1. D. M. Burton, *Elementary Number Theory,* 6th edition, Tata McGraw Hill Edition, Indian reprint, 2007.
2. T. M. Apostol, *Introduction to Analytic Number Theory,* Narosa Publication House, New Delhi, 2013.

REFERENCE BOOKS

1. N. Robbins**,** *Beginning Number Theory,* 2nd edition, Jones & Bartlett Learning, 2017.
2. G. A. Jones and J.M. Jones. *Elementary Number Theory,* Springer, 1998.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

CO-PO and CO-PSO matrix for the course Number Theory (DEMH-604A)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	2	3	2	3	3	3	3	2
CO2	2	2	3	3	3	3	3	3	2	3	3	3	3	2
CO3	3	3	3	3	3	3	2	2	3	2	3	2	2	3
CO4	2	3	2	3	3	2	3	3	3	3	3	2	3	3
Average	2.5	2.7	2.5	3	2.7	2.75	2.5	2.75	2.75	2.75	3	2.25	2.75	2.25

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

S. No.	Course Name	Course Code	Employability	Entrepreneurship	Skill Development
1.	Calculus	BMH-101A	3	1	2
2.	Algebra	BMH-102A	3	1	2
3.	Calculus (Lab)	BMH-103A	2	2	3
4.	Real Analysis	BMH-201A	3	1	2
5.	Differential Equations	BMH-202A	3	1	2
6.	Differential Equations (Lab)	BMH-203A	2	2	3
7.	Probability and Statistics	BMH-301A	3	1	2
8.	Group Theory	BMH-302A	3	1	2
9.	Multivariate Calculus	BMH-303A	3	1	2
10.	Multivariate Calculus (Lab)	BMH-304A	2	2	3
11.	Latex	SEC-301A	3	2	2
12.	Analytical Geometry	BMH-401A	3	1	2
13.	Ring Theory and Linear Algebra	BMH-402A	3	1	2
14.	Partial Differential Equations	BMH-403A	3	1	2
15.	Partial Differential Equations (Lab)	BMH-404A	2	2	3
16.	Seminar	SEC-401A	3	2	2
17.	Mechanics-I	BMH-501A	3	1	2
18.	Numerical Methods	BMH-502A	3	1	2
19.	Numerical Methods (Lab)	BMH-503A	2	2	3
20.	Discrete Mathematics	DEMH-501A	3	1	2
21.	Mathematical Modeling	DEMH-502A	3	1	2
22.	Special Functions and Integral Transform	DEMH-503A	3	1	2
23.	Application of Algebra & Graph Theory	DEMH-504A	3	1	2
24.	Linear Programming	DEMH-505A	3	1	2
25.	Complex Analysis	BMH-601A	3	1	2
26.	Set Theory and Metric Space	BMH-602A	3	1	2
27.	Complex Analysis (Lab)	BMH-603A	2	2	3
28.	Financial Mathematics	DEMH-601A	3	1	2
29.	Mechanics-II	DEMH-602A	3	1	2
30.	Riemann Integral	DEMH-603A	3	1	2
31.	Number Theory	DEMH-604A	3	1	2