Scheme and Syllabi

B.Sc. MATHEMATICS and COMPUTING

Outcome Based Education System (OBES)/

Learning Outcomes based Curriculum Framework (LOCF)

Choice Base Credit System (CBCS)

ACADEMIC SESSION

(w.e.f. Session 2022-2023)

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.

About The Program

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. Keeping this in view, our department is already offering the undergraduate course in Mathematics (B.Sc. Mathematics) since 2018. As we are living the world of science and computers today, therefore, a course in computer science with solid mathematics foundation is the current demand of the society. The data from other institutes (within and outside India) where similar programs are running, indicates that the proposed course is a very successful program and provides a good career opportunities in MNCs related to finance sector, IT sector and in research & development section. Moreover, students may pursue their higher studies in different areas such as M.Sc. in Mathematics, M.Sc. in Computer Science, MCA, MTech., integrated M.Sc. & Ph.D. programmes, MBA etc.

As mentioned earlier, there are various job opportunities in various fields for the graduates of B.Sc. Mathematics and Computing. These sectors are given below

- Software Sector
- Insurance & Finance Sector
- Banking Sector
- Information Technology Sector
- Machine Learning Assisted Technologies
- Big Data Analysis Sector
- Image Processing Sector and many more.

Moreover, the graduates will have opportunities for higher studies. In fact as per make in India slogan, the graduates will have opportunities for their own Start-ups. Various other jobs are also available for these graduates in government sector. For example, various exams are being conducted by UPSC every year for recruiting such graduate students to several posts.

For that reason this career option is popular among the graduates of B.Sc. Mathematics and Computing.

J.C. BOSEUNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD
DEPARTMENT OF MATHEMATICS
SCHEME
B.Sc. MATHEMATICS and COMPUTING
(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	6	0	0	25	75	100	6	DCC
BMH-103A	Calculus (Lab)	0	0	4	15	35	50	2	DCC
BCA-17-101	Computer &Programming Fundamentals	5	0	0	25	75	100	5	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 6 credit course along with respective Lab (if available) from the following:									
BSC-101-D	Semiconductor Physics	4	0	0	25	75	100	4	OEC
BSC-104-D	Semiconductor Physics lab	0	0	4	15	35	50	2	OEC
OCSC-101A	Introduction to Programming	4	0	0	25	75	100	4	OEC
OCSC-102A	Introduction to Programming(Lab)	0	0	4	15	35	50	2	OEC
BMH-301-A	Probability and Statistics	6	0	0	25	75	100	6	OEC
Massive Open Online Course (MOOC)**- Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	Min 4	0	0	25	75	100	4	MOOC
Total Credits								**25**	

*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	6	0	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
BCA-17-108	Mathematical Foundations of Computer Science	5	0	0	25	75	100	5	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 6 credit course along with respective Lab (if available) from the following:									
BSC-101A	Introduction to Electromagnetic Theory	4	0	0	25	75	100	4	OEC
BSC-104A	Introduction to Electromagnetic theory (Lab)	0	0	4	15	35	50	2	OEC
OCSC-201A	Introduction to Database System	4	0	0	25	75	100	4	OEC
OCSC-202A	Introduction to Database System (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	Min 4	0	0	25	75	100	4	MOOC
Mandatory Audit Course(MAC)									
XXX	Audit Course #	2	0	0	25	75	100	0	AUD
Total Credits								**25**	

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-302A	Group Theory	6	0	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
BCA-17-201	Introduction to Operating System	5	0	0	25	75	100	5	DCC
Skill Enhancement Course(SEC)–Select one course from the following:									
SEC-301A	Seminar	2	0	0	25	75	100	2	SEC
SEC-302A	French-I	2	0	0	25	75	100	2	SEC
SEC-303-A	German-I	2	0	0	25	75	100	2	SEC
Open Elective Course (OEC-3)– Select one 6 credit course along with respective Lab (if available) from the following:									
OCSC-301A	Computer Networks & Internet Technology	4	0	0	25	75	100	4	OEC
OCSC-302A	Computer Networks& Internet Technology (Lab)	0	0	4	15	35	50	2	OEC
OPHY-301A	Fundamentals of Waves & Optics	4	0	0	25	75	100	4	OEC
OPHY-302A	Wave & Optics (Lab)	0	0	4	15	35	50	2	OEC
BMH-501A	Mechanics-I	6	0	0	25	75	100	6	OEC
Massive Open Online Course (MOOC)**- Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	Min 4	0	0	25	75	100	4	MOOC
Total Credits								**25**	

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	6	0	0	25	75	100	6	DCC
BMH-402A	Ring Theory & Linear Algebra	6	0	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 :									
PCC-WD-203	Web Designing	3	0	0	25	75	100	3	SEC
OEC-CS-601(III)	Data Analytics using Python	3	0	0	25	75	100	3	SEC
Open Elective Course(OEC-4)-Select Select one 6 credit course along with respective Lab (if available) from the following:									
OCSC-401A	Information Security	4	0	0	25	75	100	4	OEC
OCSC-402A	Information Security(Lab)	0	0	4	15	35	50	2	OEC
OPHY-401A	Fundamentals of Nuclear and Particle Physics	6	0	0	25	75	100	6	OEC
Massive Open Online Course (MOOC)–Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	Min 4	0	0	25	75	100	4	MOOC
Total Credits								**27**	

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-502A	Computational Techniques	4	0	0	25	75	100	4	DCC
BMH-503A	Computational Techniques (Lab)	0	0	4	15	35	50	2	DCC
BCA-17-301	Object Technologies & Programming using Java	4	0	0	25	75	100	4	DCC
BCA-17-301A	Object Technologies & Programming using Java (Lab)	0	0	4	15	35	50	2	DCC
Discipline Elective Course (DEC) –Select any two courses from the following:									
DEMH-501A	Discrete Mathematics	6	0	0	25	75	100	6	DEC
DEMH-502A	Mathematical Modeling	6	0	0	25	75	100	6	DEC
DEMH-503A	Special Functions and Integral Transforms	6	0	0	25	75	100	6	DEC
DEMH-505A	Linear Programming	6	0	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	Min 4	0	0	25	75	100	4	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-603A	Complex Analysis (Lab)	0	0	4	15	35	50	2	DCC
BCA-17-308	Artificial Intelligence	5	0	0	25	75	100	5	DCC
Discipline Elective Course (DEC) – Select any two courses from the following:									
DEMH-601A	Financial Mathematics	6	0	0	25	75	100	6	DEC
DEMH-602A	Mechanics-II	6	0	0	25	75	100	6	DEC
DEMH-603A	Riemann Integral	6	0	0	25	75	100	6	DEC
DEMH-604A	Number Theory	6	0	0	25	75	100	6	DEC
Total Credits								**23**	

B.Sc. Mathematics and Computing

Syllabi of Semester I

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-I
Discipline Core Course (DCC)
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 eachof 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	2	2	1	2	2	3	2	2	1	2
CO3	3	3	3	3	2	2	3	2	2	3	2	3	2	2
CO4	3	3	2	2	3	3	3	3	3	3	3	3	3	2
Average	3	2.75	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.75	2.5	2.8	2.3	2.3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-I
Discipline Core Course (DCC)
CODE: BMH-102A
SUBJECT NAME: Algebra
No. of Credits: 6

L	T	P		
6	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 eachof 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
CO2	3	3	3	2	3	2	2	3	2	3	2			2
CO3	3	3	3	3	3	2	3	3	3	3	3			3
CO4	3	2	3	3	2	3	3	3	2	3	3			2
Average	3	2.5	3	2.75	2.75	2.25	2.75	3	2.25	2.75	2.75			.25

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-I
Discipline Core Course (DCC)
CODE: BMH-103A
SUBJECT NAME: Calculus (Lab)
No. of Credits: 2

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

COURSE OUTCOMES:
Students will be able to
CO1: Write computer program for different types of graphs.
CO2: Write computer program for the tracing of conics.
CO3: Write computer program for different matrices operations.
CO3: Write computer program for sketching of Hyperbolic functions.

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

CO-PO and CO-PSO matrix for the course Calculus (Lab) (BMH-103A)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	2	2	1	2	2	3	2	2	1	2
CO3	3	3	3	3	2	2	3	2	2	3	2	3	2	2
CO4	3	3	2	2	3	3	3	3	3	3	3	3	3	2
Average	3	2.75	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.75	2.5	2.8	2.3	2.3

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-I
Discipline Core Course (DCC)
CODE: BCA-17-101
SUBJECT NAME: Computer & Programming Fundamentals
No. of Credits: 5

L	T	P		
5	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 eachof 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: Understand how the computer systems evolved and about the various types of memories used by a computer system.
CO2: Understand of various hardware and software components, different functions of operating system and the knowledge of computer viruses.
CO3: Solve and implement the problems using basic programming
CO4: Analyze the concept of internet, intranet and essential concepts related to computer networking.

UNIT – I

Computer Fundamentals: Generations of Computers, Definition, Block Diagram along with its components, characteristics & classification of computers, Limitations of Computers, Human-Being VS Computer, Applications of computers in various fields.

Memory: Concept of primary & secondary memory, RAM, ROM, types of ROM, Cache Memory, flash memory, Secondary storage devices: Sequential & direct access devices viz. magnetic tape, magnetic disk, optical disks i.e. CD, DVD, virtual memory.

UNIT – II

Computer hardware & software: I/O devices, definition of software, relationship between hardware and software, types of software.
Overview of operating system: Definition, functions of operating system, concept of multiprogramming, multitasking, multithreading, multiprocessing, time-sharing, real time, single- user & multi-user operating system.
Computer Virus: Definition, types of viruses, Characteristics of viruses, anti-virus software.

UNIT – III

Computer Languages: Analogy with natural language, machine language, assembly language, high-level languages, fourth generation languages, compiler, interpreter, assembler, Linker, Loader , characteristics of a good programming language, Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation, Structured programming concepts, Programming methodologies viz. top-down and bottom- up programming, Advantages and disadvantages of Structured programming

UNIT – IV

Overview of Networking: An introduction to computer networking, Network types (LAN, WAN, MAN), Network topologies, Modes of data transmission, Forms of data transmission, Transmission channels(media), Introduction to internet and its uses, Applications of internet, Hardware and Software requirements for internet, Intranet, Applications of intranet.

TEXT BOOKS

1. Gill Nasib Singh: Computing Fundamentals and Programming in C, Khanna Books Publishing Co., New Delhi.
2. Balagurusamy E, Computing Fundamentals and C Programming, Tata McGraw Hill.
3. Norton, Peter, Introduction to Computer, McGraw-Hill
4. Leon, Alexis & Leon, Mathews, Introduction to Computers, Leon Tech World
5. Rajaraman, V., Fundamentals of Computers, PHI
6. Ram, B., Computer Fundamentals, Architecture & Organization, New Age International (P) Ltd.
7. Chhillar, Rajender Singh: Application of IT to Business, Ramesh Publishers, Jaipur.
8. Gill, Nasib Singh: Essentials of Computer and Network Technology, Khanna Books Publishing Co., New Delhi

CO-PO and CO-PSO matrix for the course Computer & Programming Fundamentals (BCA-17-101)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	2	2	1	2	2	3	2	2	1	2
CO3	3	3	3	3	2	2	3	2	2	3	2	3	2	2
CO4	3	3	2	2	3	3	3	3	3	3	3	3	3	2
Average	3	2.75	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.75	2.5	2.8	2.3	2.3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER- I
Ability Enhancement Compulsory Course (AECC)
CODE: BENG-101A
SUBJECT NAME: English
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 eachof 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.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER- I
Open Elective Course (OEC)
CODE: BSC-101D
SUBJECT NAME: Semiconductor Physics
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 eachof 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:
Electronic materials (8)
Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.

Unit - II:
Semiconductors (10)
Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

Unit - III:
Light-semiconductor interaction (6)
Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

Unit - IV:
Measurements (6)
Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis spectroscopy, absorption/transmission.

Unit -V:

Engineering semiconductor materials (6)

Density of states in 2D, 1d and 0D (qualitatively). Practical examples of low dimensional systems such as quantum wells, wires, and dots: design, fabrication, and characterization techniques. Hetero junctions and associated band-diagrams

REFERENCES:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, OxfordUniversity Press, New York (2007).
5. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL
7. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Guptaon NPTEL

B.Sc. MATHEMATICS and **COMPUTING**
SEMESTER- I
Open Elective Course (OEC)
CODE: BSC-104D
SUBJECT NAME: Semiconductor Physics (Lab)
NO. OF CREDITS: 2

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

At least 6 experiments from the following:

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a two stage RC-coupled transistor amplifier.
7. To study Hall effect and to determine hall coefficient for a semiconductor specimen.
8. To study the four –probe method and to determine the energy gap of a semiconductor specimen using Four – probe technique.
9. To find out the unknown low resistance by using Carey-Fosters bridge.
10. To determine the high resistance by substitution method.
11. To compare the capacitance of two capacitors by using De-Sauty's bridge.

REFERENCE:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4. Electronic Devices & circuit Theory, R.L.Boylestad & L.D.Nashelsky, 2009, Pearson.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-I
Open Elective Course (OEC)
CODE: OCSC-101A
SUBJECT NAME: Introduction To Programming
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: 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.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-I
Open Elective Course (OEC)
CODE: OCSC-102A
SUBJECT NAME: Introduction to Programming (Lab)
NO OF CREDITS: 2

			Internal Assessment:	35
L	**T**	**P**	End Semester:	15
0	0	4	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.

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.

B.Sc. MATHEMATICS and **COMPUTING**
SEMESTER- I
Open Elective Course (OEC)
CODE: BMH-301A
SUBJECT NAME: Probability and Statistics
NO OF CREDITS: 6

L	T	P	Internal Assessment: 25 End Semester: 75 Total: 100
6	0	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 student 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 behavior 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	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)

B.Sc. Mathematics and Computing

Syllabi of Semester II

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-II

Discipline Core Course (DCC)
CODE: BMH-201A
SUBJECT NAME: Real Analysis
NO. OF CREDITS: 6

L	T	P
6	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: Explore many properties of the real line 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 and limit comparison test for convergence of positive term infinite series and absolute convergence of an alternating series.

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	--	2	2	2	2	3	3	3
CO2	3	3	3	3	3	3	--	2	2	3	2	3	3	3
CO3	3	3	3	2	3	3	--	3	2	3	2	3	2	3
CO4	3	3	2	3	2	2	--	3	2	3	2	3	2	2
Average	3	3	2.7	2.5	2.7	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)

SEMESTER-II
Discipline Core Course (DCC)
CODE: BMH-202A
SUBJECT NAME: 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:

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	3	3	3	--	2	3
CO2	3	2	3	3	3	--	--	2	3	3	--	3	3	2
CO3	3	2	--	3	--	2	3	-	3	3	3	3	--	2
CO4	3	1	3	3	2	2	3	2	3	3	2	1	3	2
Average	3	1.8	2	2.8	1.8	1.5	1.5	1.5	3	3	2	1.8	2	2.3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER -II

Discipline Core Course (DCC)
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

COURSE OUTCOMES:

Students will be able to

CO1: Write computer program for different types of differential equations.

CO2: Write computer program for plotting sequences.

CO3: Write computer program for the various methods for solving differential equations.

CO4: Write computer program for different types of Mathematical Models.

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.

CO-PO and CO-PSO matrix for the course Differential Equations (Lab) (BMH-203A)

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)

B.Sc. MATHEMATICS and COMPUTING
SEMESTER –II
Discipline Core Course (DCC)
CODE: BCA-17-108
SUBJECT NAME: Mathematical Foundations of Computer Science
NO. OF CREDITS: 5

L	T	P	Internal Assessment:	25
5	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 OBJECTIVES:

CO1: To recognize the importance and value of mathematical and statistical thinking, training, and approach
to problem solving, on a diverse variety of disciplines
CO2: To understand and apply the fundamental concepts in graph theory
CO3: To acquire ability to describe problems and their complexity in a formal mathematical manner CO4: To develop a deeper conceptual understanding of the theoretical basis of number theory and cryptography

UNIT - I
Basic Statistics: Measure of Central Tendency, Preparing frequency distribution table, Mean, Mode, Median, Measure of Dispersion: Range, Variance and Standard Deviations, Correlationand Regression.

UNIT - II
Algorithm: Algorithms, merits and demerits, Exponentiation, How to compute fast exponentiation. Linear Search, Binary Search, "Big Oh" notation, Worst case, Advantage of logarithmic algorithms over linear algorithms, complexity. **Graph Theory:** Graphs, Types of graphs, degree of vertex, sub graph, isomorphic and homeomorphic graphs, Adjacent and incidence matrices, Path Circuit ; Eulerian, Hamiltonian path circuit.

UNIT - III
Tree: Trees, Minimum distance trees, Minimum weight and Minimum distance spanning trees.
Recursion: Recursively defined function. Merge sort, Insertion sort, Bubble sort, and Decimal to Binary.

UNIT - IV

Recurrence Relations: LHRR, LHRRWCCs, DCRR. Recursive procedures.

Number Theory: Principle of Mathematical induction**,** GCD, Euclidean algorithm, Fibonacci numbers, congruences and equivalence relations, public key encryption schemes.

REFERENCES:

1. Gupta S.P. and Kapoor, V.K., Fundamentals of Applied statistics, Sultan Chand & Sons, 1996.
2. Gupta S.P. and Kapoor, V.K., Fundamentals of Mathematical statistics, Sultan Chand and Sons, 1995.
3. Graybill, Introduction to Statistics, McGraw.
4. Anderson, Statistical Modelling, McGraw.
5. Babu Ram : Discrete Mathematics

CO-PO and CO-PSO matrix for the course Mathematical Foundations of Computer Science (BCA-17-108)

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
CO2	3	2	3	3	3	--	--	2	3	3	--	3	3	2
CO3	3	2	--	3	--	2	3	-	3	3	3	3	--	2
CO4	3	1	3	3	2	2	3	2	3	3	2	1	3	2
Average	3	1.8	2	2.8	1.8	1.5	1.5	1.5	3	3	2	1.8	2	2.3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER- II
Ability Enhancement Compulsory Course (AECC)
CODE: BEVS-101A
SUBJECT NAME: Environmental Science
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.

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.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER- II
Open Elective Course (OEC)
CODE: BSC-101A
SUBJECT NAME: Introduction to Electromagnetic Theory
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.

Unit I:
Electrostatics in vacuum (8)
Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Unit II:
Electrostatics in a linear dielectric medium (4)
Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectricsphere in uniform electric field.

Unit III:
Magnetostatics (6)
Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Unit IV:
Magnetostatics in a linear magnetic medium (3)
Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and feromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Unit V:
Faraday's law (4)
Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing

magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Unit VI:

Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations (5)

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time- dependent electric field; calculating magnetic field due to changing electric fields in quasi- static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Unit VII:

Electromagnetic waves (8) The wave equation; Plane electromagnetic waves in vacuum, their ransverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non- conducting medium-vacuum interface for normal incidence.

TEXTBOOK:

1. David Griffiths, Introduction to Electrodynamics

REFERENCE

1. Halliday and Resnick, Physics
2. W. Saslow, Electricity, magnetism and light

B.Sc. MATHEMATICS and COMPUTING
SEMESTER- II
Open Elective Course (OEC)
CODE: BSC-104A
SUBJECT NAME: Introduction to Electromagnetic Theory (Lab)
NO OF CREDITS: 2

L	T	P
0	0	4

Internal Assessment:	15
End Semester:	35
Total:	50

At least 6 experiments from the following:

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's airfilm.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for airglass interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine Boltzmann constant using V-I characteristics of PN junction diode.

Note: Experiments may be added or deleted as per the availability of equipments.

REFERENCE:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-II
Open Elective Paper
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.

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

L	T	P
0	0	4

Internal Assessment:	15
End Semester:	35
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).

B.Sc. Mathematics and Computing

Syllabi of Semester III

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

	Internal Assessment: 25
L T P	End Semester: 75
6 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:

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 ,3rdEdition, 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)

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Discipline Core Course (DCC)
CODE: BMH-303A
SUBJECT NAME: **Multivariate Calculus**
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: 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	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
Average	3	2	2	3	1.75	3	2.5	1.25	2	1.25	2.5	3	2.5	3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Discipline Core Course (DCC)
CODE: BMH-304A
SUBJECT NAME: Multivariate Calculus (Lab)
NO OFCREDITS: 2

L	T	P
0	0	4

Internal Assessment:	15
End Semester:	35
Total:	50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Know about MATLAB desktop.
CO2: Understand the fundamental operations in MATLAB and write basic programs.
CO3: Analyze plots and export this for use in their reports.
CO4: Develop codes to visualize maxima/minima for surfaces.

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 to0
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.

CO-PO and CO-PSO matrix for the course Multivariate Calculus (Lab) (BMH-304A)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
Average	3	2	2	3	1.75	3	2.5	1.25	2	1.25	2.5	3	2.5	3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Discipline Core Course (DCC)
CODE: BCA-17-201
SUBJECT NAME: **Introduction to Operating System**
NO OF CREDITS: 5

	Internal Assessment:	25
L T P	End Semester:	75
5 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 :

CO1: The students will be familiar with various types of OS and will also understand the various functions of OS.
CO2: The students will be able to understand CPU scheduling along with its various algorithms.
CO3: The students will be familiar with different deadlock handling algorithms.
CO4: The students will become familiar with various memory management schemes like demand paging and segmentation and also able to understand virtual memory and page replacement algorithms.
CO5: The students will be able to understand disk scheduling and different file handling schemes in OS.

UNIT – I
Fundamentals of Operating system: Introduction to Operating System, its need and operating System services, Early systems, Structures - Simple Batch, Multi programmed, timeshared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems. Process Management: Process concept, Operation on processes, Cooperating Processes, Threads, and Inter-process Communication.

UNIT-II
CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms: FCFS, SJF, Round Robin & Queue Algorithms. Deadlocks: Deadlock characterization, Methods for handling deadlocks, Banke's Algorithm.

UNIT-III
Memory Management: Logical versus Physical address space, Swapping, Contiguous allocation, Paging, Segmentation. Virtual Memory: Demand paging, Performance of demand paging, Page replacement, Page replacement algorithms, Thrashing.

UNIT-IV

File management: File system Structure, Allocation methods: Contiguous allocation, Linked allocation, Indexed allocation, Free space management: Bit vector, Linked list, Grouping, Counting. Device Management: Disk structure, Disk scheduling: FCFS,SSTF, SCAN, C-SCAN, LOOK, C-LOOK.

TEXT BOOKS:

1. Abraham Silberschatz, Peter B. Galvin, " Operating System Concepts", AddisonWesley publishing. Co., 7th. Ed., 2004.
2. Nutt Gary, "Operating Systems", Addison Wesley Publication, 2000.

REFERENCE BOOKS:

1. Andrew S. Tannenbaum, "Modern Operating Systems", Pearson Education Asia,Second Edition, 2001.
2. William Stallings, "Operating Systems, "Internals and Design Principles", 4th Edition,PH, 2001.
3. Ekta Walia, "Operating Systems Concepts", Khanna Publishes, New Delhi, 2002.

CO-PO and CO-PSO matrix for the course Introduction to Operating System (BCA-17-201)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
Average	3	2	2	3	1.75	3	2.5	1.25	2	1.25	2.5	3	2.5	3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Skill Enhancement Course (SEC)
CODE: SEC-301A
SUBJECT NAME: Seminar
NO OF CREDITS: 2

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

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.

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

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

NOTE: 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. 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
2. B.LE NOUVEAU SANS FRONTIERESMethode de Francais by Philippe Domonique, Jacky Girardet.
3. Took reference from Bhartia VidyaBhawaninstitute of foreign languages.

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

L T P	Internal Assessment: 25
2 0 0	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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Open Elective Course (OEC)
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, PearsonEducation, 2000.
6. Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, Addison Wesley, Low Price Edition, 2000.

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

L T P	Internal Assessment: 15
0 0 4	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 rowspan="3">Some image here</td><td rowspan="3"></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>Content is 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

Frame 1
Frame 2

Frame 1	
Frame 2	**Frame 3**

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

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

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List of Practical's using Java script:

Create event driven program for following:

1. Printatableofnumbersfrom5 to 15and 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.
6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the List.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Open Elective Course (OEC)
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 their uses.

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. Addison-Wesley Series.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Open Elective Course (OEC)
CODE: OPHY-302A
SUBJECT NAME: Waves & Optics (Lab)
NO. OF CREDITS – 2

L T P	Internal Assessment: 15
0 0 4	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 Physics Practicals, , 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.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-III
Open Elective Course (OEC)
CODE: BMH-501A
SUBJECT NAME: Mechanics-I
NO OF CREDITS: 6

	Internal Assessment:	25
L T P	End Semester:	75
6 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: 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.

TEXTBOOKS

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, LibWright 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	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	2	2	2	2	3	3	3	3
Average	3	2	2	3	1.8	3	2.25	1.25	1.75	1.3	2.5	3	2.5	3

B.Sc. Mathematics and Computing

Syllabi of Semester IV

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

	Internal Assessment:	25
L T P	End Semester:	75
6 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:
This course will enable the students to:

CO1: Classify the general equations of second degree into different conics
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, NarosaPublishing 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	2	3	1	2	1	1	--	--	2	3	3	2
CO2	3	1	1	3	2	2	2	--	1	--	2	3	3	3
CO3	3	1	1	3	2	2	2	1	1	--	2	3	3	3
CO4	3	2	2	3	1	2	1	--	--	--	2	3	2	3
Average	3	1.5	1.5	3	1.5	2	1.5	0.5	0.5	--	2	3	2.75	2.75

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

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

	Internal Assessment: 25
L T P	End Semester: 75
6 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:

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	2	--	3	2	2	3	2	3	3
CO2	2	3	3	3	3	2	1	--	3	2	2	1	2	3
CO3	3	1	1	3	1	2	3	3	3	3	3	1	2	3
CO4	--	3	2	1	3	2	2	2	2	3	2	3	3	2
Average	2	2.25	2	2	2.5	2	1.5	2	2.5	2.5	2.5	1.5	2.5	2.75

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-IV
Discipline Core Course (DCC)
CODE: BMH-403A
SUBJECT NAME: Partial Differential Equations
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:
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	3	2	2	2	2	3	2	3	--	2	2	2	--
CO2	3	--	2	3	2	2	2	3	--	3	3	3	3	3
CO3	--	2	3	3	--	2	--	2	3	3	--	3	3	3
CO4	3	3	3	3	2	2	2	2	--	2	3	2	--	2
Average	2.2	2	2.5	2.8	1.8	2	1.8	2.2	1.5	2	2	2.5	2	2

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

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

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

COURSE OUTCOMES:

Students will be able to
CO1: Write computer program for plotting three dimensional graphs.
CO2: Write computer program for solving Cauchy problem.
CO3: Write computer program for the solution of different types of second order PDE.
CO4: Write computer program for non-linear systems of PDE.

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 andYi-TungChen,Computational partial differential equationsusingMATLAB, 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, Anintroduction to partial differentialequations with MATLAB, 2013.

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

CO-PO and CO-PSO matrix for the course Partial Differential Equations (Lab) (BMH-404A)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	3	2	3	--	2	2	2	3
CO2	3	--	2	3	2	2	2	3	--	3	3	3	3	3
CO3	--	2	3	3	--	2	--	2	3	3	--	3	3	3
CO4	3	3	3	3	2	2	2	2	--	2	3	2	--	3
Average	2.2	2	2.5	2.8	1.8	2	1.8	2.2	1.5	2	2	2.5	2	3

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

B.Sc. MATHEMATICS and COMPUTING

SEMESTER-IV
Skill Enhancement Course (SEC)
CODE: PCC-WD-203
SUBJECT NAME: Web Designing
NO. OF CREDITS – 3

	Internal Assessment: 25
L T P	End Semester: 75
3 0 0	Total: 100

COURSE OUTCOMES:

Candidates will be able to:

CO1: Discover how does web works really, what makes web sites work.

CO2: Employ fundamental computer theory to basic programming techniques.

CO3: Create an Information Architecture document for a web site.

CO4: How to and where to start research, planning for website

CO5: Use fundamental skills to maintain web server services required to host a website.

Unit-I
Web Design Principles : Basic Principles involved in developing a web site, Planning process, Five Golden rules of Web Designing, World Wide Web, Why create a web site, Web Standards

Unit-II
Introduction to HTML : What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags. Elements of HTML: Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames; Working with Hyperlinks, Images and Multimedia; Working with Forms and controls.

Unit- III
Introduction to Cascading Style Sheets: Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties), CSS Color, Creating page Layout and Site Designs.

Unit-IV
JavaScript introduction : What is JavaScript, Understanding Events, JavaScript Example, External JavaScript

TEXT BOOKS:

1. Satish Jain, Ambrish K. Rai and M. Geetha, Web Designing and Development, BPB Publications.
2. Hirdesh Bhardwaj, Web Designing.
3. Jon Duckett, HTML & CSS: Design and Build Web Sites

CO-PO and CO-PSO matrix for the course Web Designing (PCC-WD-203)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
Average	3	2	2	3	1.75	3	2.5	1.25	2	1.25	2.5	3	2.5	3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-IV
Skill Enhancement Course (SEC)
CODE: OEC-CS-601(III)
SUBJECT NAME: Data Analytics using Python
NO. OF CREDITS – 3

	Internal Assessment: 25
L T P	End Semester: 75
3 0 0	Total: 100

COURSE OUTCOMES:
After completion of course, students would be able to:
CO1: Write programs efficiently in python
CO2: Effectively use numerical analysis libraries of python
CO3: Carry out basic data science operations like retrieving, processing and visualizing using python.

Unit I: INTRODUCTION TO PYTHON
Brief history of python, Data types - Built-in, Sequence, Sets, Strings, Literals, constants, keywords, variables, naming convention. Operators – Types, Precedence & Associativity, Input, Output, file handling, Control Statements.

Unit II: FUNCTIONS AND DATA STRUCTURES IN PYTHON
Functions – basics of functions, functions as objects, recursive functions, List –methods to process lists, Shallow & Deep copy, Nested lists, lists as matrices, lists as stacks, Queues, - Deques, Tuples - basic operations on tuples, nested tuples, Dictionaries – operations on dictionary, ordered dictionary, iteration on dictionary, conversion of lists & strings into dictionary, Sets & frozen sets, looping techniques on lists & dictionaries, Lamda, filter, reduce, map, list comprehension, iterators and generators.

Unit III: OBJECTS IN PYTHON
Class and instance attributes, inheritance, multiple inheritance, methos resolution order, magic methods and operator overloading, meta classes, abstract and inner classes, exception handling, modular programs and packeges.

Unit IV: NUMERICAL ANALYSIS IN PYTHON
Introduction to NumPy, NumPy array object, Creating a multidimensional array, NumPy numerical types - Data type objects, Character codes, dtype constructors. dtype attributes. Onedimensional slicing and indexing. Manipulating array shapes -- Stacking arrays, Splitting NumPy arrays, NumPy array attributes, Converting arrays, Creating array views and copies. Indexing with a list of locations. Indexing NumPy arrays with Booleans. Broadcasting NumPy arrays.

Unit V: DATA MANIPULATION AND VISUALIZATION IN PYTHON

Data frames in panda, Creating dataframes from .csv and excel files, Lists of tuples, Dataframes aggregation and concatenation, plotting data using matplotlib & panda

TEXT BOOKS:

1. Wesley J Chun, Core Python Programming, Prentice Hall, Second Edition, 2006
2. Ivan Idris, Python Data Analysis, Packt Publishing,UK, 2014 (freely available online)
3. Wes McKinney, Python for Data Analysis, O'Reilly – 2013

CO-PO and CO-PSO matrix for the course Data Analytics using Python (OEC-CS-601(III))

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
Average	3	2	2	3	1.75	3	2.5	1.25	2	1.25	2.5	3	2.5	3

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

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-IV
Open Elective Course (OEC)
CODE: OCSC-401A
SUBJECT NAME: Information Security
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:

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.

TEXT 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. Pledger, Security in computing, 4th Edition Pearson,New Delhi,2018.

B.Sc. MATHEMATICS and COMPUTING
SEMESTER-IV
Open Elective Course (Lab)
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’

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

	Internal Assessment:	25
L T P	End Semester:	75
6 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:

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.

TEXT 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.

B.Sc. Mathematics and Computing

Syllabi of Semester V

B.Sc. Mathematics and Computing
SEMESTER V
Discipline Core Course (DCC)
CODE: BMH-502A
SUBJECT NAME: Computational Techniques
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.

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.

UNIT-IV

Numerical Solution of O.D.E: Taylor's Series, Picard's Method, Euler Method, Modified Euler's Method, Runge Kutta Second and Fourth Order Method.

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/
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	1	2	2	1	2	1	--	1	1	2	2	2	3
CO2	3	2	2	3	1	2	2	--	1	1	3	3	3	3
CO3	2	2	3	3	1	3	3	1	1	1	3	3	3	2
CO4	3	2	3	3	1	3	3	1	1	1	2	2	2	2
Average	2.7	1.75	2.5	2.75	1	2.5	2.25	0.5	1	1	2.5	2.5	2.5	2.5

B.Sc. Mathematics and Computing
SEMESTER V
Discipline Core Course (DCC)
CODE: BMH-503A
SUBJECT NAME: Computational Techniques (Lab)
NO OF CREDITS: 2

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

Students will be able to

CO1: Create computer program for different types of interpolation formulae.

CO2: Create computer program for the root finding of an equation.

CO3: Create computer program for the solution of Simultaneous Algebraic Equations.

CO4: Create computer program for Numerical Integration.

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

CO-PO and CO-PSO matrix for the course Numerical Methods (Lab) (BMH-503A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	2	1	2	1	--	1	1	2	2	2	3
CO2	3	2	2	3	1	2	2	--	1	1	3	3	3	3
CO3	2	2	3	3	1	3	3	1	1	1	3	3	3	2
CO4	3	2	3	3	1	3	3	1	1	1	2	2	2	2
Average	2.7	1.75	2.5	2.75	1	2.5	2.25	0.5	1	1	2.5	2.5	2.5	2.5

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

B.Sc. Mathematics and Computing
SEMESTER V
Discipline Core Course (DCC)
CODE: BCA-17-301
SUBJECT NAME: Object Technologies & Programming using Java
NO OF CREDITS: 5

	Internal Assessment:	25
L T P	End Semester:	75
5 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: Understand the differentiate between various programming paradigms available and familiar with the basic concept of the Java.
CO2: Implement the classes using proper syntax and applying the various features of the language.
CO3: Implement abstract classes, polymorphism, inheritance and file handling to solve the complex problem.
CO4: Implement the concepts of java programming like multithreading packages and the exceptions handling.

UNIT-I

Object Oriented Methodology-1: Paradigms of Programming Languages, Evolution of OO Methodology, Basic Concepts of OOApproach, Comparison of Object Oriented and Procedure Oriented Approaches, Benefits of OOPs, Introduction to Common OO Language, Applications of OOPs.

Object Oriented Methodology-2: Classes and Objects, Abstraction and Encapsulation, Inheritance, Method Overridingand Polymorphism.

UNIT-II

Java Language Basics*:* Introduction to Java, Basic Features, Java Virtual Machine Concepts, Primitive Data Type and Variables, Java Operators, Expressions, Statements and Arrays.

Object Oriented Concepts: Class and Objects-- Class Fundamentals, Creating objects , Assigning object reference variables; Introducing Methods, Static methods, Constructors ,Overloading constructors; This Keyword; Using Objects as Parameters, Argument passing, Returning objects , Method overloading, Garbage Collection, The Finalize ( ) Method.

Inheritance and Polymorphism: Inheritance Basics, Access Control, Multilevel Inheritance, Method Overriding, Abstract Classes, Polymorphism, Final Keyword.

UNIT-III

Packages: Defining Package, CLASSPATH, Package naming, Accessibility of Packages, using Package Members.

Interfaces: Implementing Interfaces, Interface and Abstract Classes, Extends and Implements together.

Exceptions Handling: Exception, Handling of Exception, Using try-catch, Catching Multiple Exceptions, using finally clause, Types of Exceptions, Throwing Exceptions, Writing Exception Subclasses.

UNIT-IV

Multithreading: Introduction, The Main Thread, Java Thread Model, Thread Priorities, Synchronization in Java, Inter thread Communication.

I/O in Java: I/O Basics, Streams and Stream Classes, The Predefined Streams, Reading from, and Writing to, Console, Reading and Writing Files, The Transient and Volatile Modifiers, Using Instance of Native Methods.

Strings and characters: Fundamentals of Characters and Strings, the String Class, String Operations, Data Conversion using Value Of ( ) Methods, String Buffer Class and Methods.

TEXT BOOKS

1. E Balagurusamy, Programming in Java
2. Herbert Schildt, The Complete Reference JAVA, TMH Publication

REFERENCE BOOKS

1. Ivor Horton, Begining JAVA, WROX Public
2. Stephen Potts, JAVA 2 UNLEASHED, Tech Media Publications
3. Patrick Naughton and Herbertz Schildt, Java-2 The Complete Reference, 1999, TMH

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/
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	1	2	2	1	2	1	--	1	1	2	2	2	3
CO2	3	2	2	3	1	2	2	--	1	1	3	3	3	3
CO3	2	2	3	3	1	3	3	1	1	1	3	3	3	2
CO4	3	2	3	3	1	3	3	1	1	1	2	2	2	2
Average	2.7	1.75	2.5	2.75	1	2.5	2.25	0.5	1	1	2.5	2.5	2.5	2.5

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

B.Sc. Mathematics and Computing
SEMESTER V
Discipline Core Course (DCC)
CODE: BCA-17-301A
SUBJECT NAME: Object Technologies & Programming using Java (Lab)
NO OF CREDITS: 2

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

Students will be able to

CO1: Create basic JAVA program.
CO2: Create JAVA program for the root finding of an equation.
CO3: Create JAVA program for sorting.
CO4: Create JAVA program for simple mathematical operations.

PRACTICALS:

1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminant $b^2 - 4ac$ is negative, display a message stating that there are no real solutions.

2. Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer.
3. Write a Java program to multiply two given matrices.
4. Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util)
5. Write a Java program that checks whether a given string is a palindrome or not: MADAM is a palindrome.
6. Write a Java program for sorting a given list of names in ascending order.
7. Write a Java program to make frequency count of words in a given text.
8. Write a Java program that reads a file name from the user, then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
9. Write a Java program that reads a file and displays the file on the screen, with align number before each line.
10. Write a Java program that displays the number of characters, lines and words in a text file.
11. Develop an applet that displays a simple message.
12. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the $+, -, *, \%$ operations. Add a text field to display the result.
13. Write a Java program for handling mouse events.
14. Develop an applet that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named "Compute" is clicked.

CO-PO and CO-PSO matrix for the course Numerical Methods (Lab) (BMH-503A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	2	1	2	1	--	1	1	2	2	2	3
CO2	3	2	2	3	1	2	2	--	1	1	3	3	3	3
CO3	2	2	3	3	1	3	3	1	1	1	3	3	3	2
CO4	3	2	3	3	1	3	3	1	1	1	2	2	2	2
Average	2.7	1.75	2.5	2.75	1	2.5	2.25	0.5	1	1	2.5	2.5	2.5	2.5

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

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

L	T	P	INTERNAL ASSESSMENT:	25
			END SEMESTER:	75
6	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: 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	2	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	1	3	3	2	3	3
CO4	2	3	2	3	3	3	3	3	1	3	3	2	3	2
Average	2.25	2.7	2.5	3	2.7	3	2.7	3	1.5	3	2.7	2.5	3	2.5

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

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

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
6 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:
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	1	3	2
CO3	3	3	3	3	3	3	3	2	3	2	3	1	3	3
CO4	2	3	2	3	3	2	3	2	2	3	3	2	1	3
Average	2.5	2.7	2.5	3	2.7	2.75	2.7	2.5	2.25	2.75	2.7	1.8	2.5	2.75

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

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

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
6 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:

This course will enable the students to:

- CO1: Describe the concept of Legendre and Hermite differential equations, Recurrence relation, and integral representation of Legendre 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 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 of Mathematical Physics & Chemistry, Oliver and Boyd Ltd.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	--	3
CO2	3	3	2	3	--	2	2	3	3	3	--	2	3	2
CO3	--	2	3	3	3	3	2	3	3	3	3	3	2	3
CO4	2	3	3	3	2	2	--	3	3	3	2	2	3	2
Average	2	2.5	2.5	2.8	1.8	2.3	1.8	3	3	3	1.8	2.3	2	2.5

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

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

L T P	INTERNAL ASSESSMENT: 25
6 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: 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 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, 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 Linear Programming (DEMH-505A)

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	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)

B.Sc. Mathematics and Computing

Syllabi of Semester VI

B.Sc. Mathematics and Computing
SEMESTER VI
Discipline Core Course (DCC)
CODE: BMH-601A
SUBJECT NAME: Complex Analysis
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: Explore complex 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	2	2	2	1	1	2	2	2	2	2	2	2
CO2	3	3	2	2	3	2	2	2	2	2	2	2	1	2
CO3	3	2	2	3	3	3	2	2	2	2	2	2	2	3
CO4	3	2	2	3	3	3	3	2	3	2	2	3	3	3
Average	3	2.25	2	2.5	2.75	2	2	2	2.25	2	2	2.25	2.75	2.5

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

B.Sc. Mathematics and Computing
SEMESTER VI
Discipline Core Course (DCC)
CODE: BMH-603A
SUBJECT NAME: Complex Analysis (LAB)
NO OF CREDITS: 2

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

COURSE OUTCOMES:

Students will be able to
CO1: Evaluate addition, multiplication, conjugate and modulus of complex numbers.
CO2: Compute contour integrals.
CO3: Expand some functions as their Taylor and Laurent series.
CO4: Evaluate poles and residues of functions.

Practical's

1. Declaring a complex number and graphical representation.
2. Program to discuss the algebra of complex numbers.
3. To find conjugate, modulus and phase angle of an array of complex numbers.
4. To compute the integral over a straight-line path between the two specified end points.
5. To perform contour integration, e.g.,

(i) where C is the Contour given by $x = y^2 + 1$.

(ii) where C is the contour given by, which can be parameterized by x = cos (t), y = sin(t).

6. To plot the complex functions and analyze the graph, e.g.,

(i) f(z) = z

(ii) $f(z) = z^4$ etc.

7. To perform the Taylor series expansion of a given function f(z) around a given point z. The number of terms that should be used in the Taylor series expansion is given for each function. Hence plot the magnitude of the function and magnitude of its Taylors series expansion. e.g. (i) f(z) = exp(z) around z = 0, n =40. (ii) $f(z)=\exp(z^2)$ around z = 0,
8. To determines how many terms should be used in the Taylor series expansion of a given function f(z) around z = 0 for a specific value of z to get a percentage error of less than 5 % e.g., For f(z) = exp(z) around z =0, execute and determine the number of necessary terms to get a percentage error of less than 5 % for the following values of z: z = 30 + 30 i
9. To perform Laurent's series expansion of a given function f(z) around a given point z. e.g., (i) $f(z)= (\sin z -1)/ z^4$ around z = 0 (ii) f(z) = cot (z)/z4 around z = 0.
10. To compute the poles and corresponding residues of complex functions.

CO-PO and CO-PSO matrix for the course Complex Analysis (Lab) (BMH-603A)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	1	2	2	2	1	2	3	2
CO2	3	2	2	2	2	2	3	2	2	2	2	3	3	2
CO3	3	3	2	2	3	3	3	2	2	2	2	3	3	2
CO4	3	2	2	2	2	3	3	2	2	2	2	2	3	2
Average	3	2	1.75	1.75	2.25	2.25	2.5	2	2	2	1.75	2.5	3	2

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

B.Sc. Mathematics and Computing
SEMESTER VI
Discipline Core Course (DCC)
CODE: BCA-17-308
SUBJECT NAME: Artificial Intelligence
NO OF CREDITS: 5

	Internal Assessment:	25
L T P	End Semester:	75
5 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: Understand achievements of AI and the theory underlying those achievements.
CO2: Review "conventional" searching methods including breadth-first, depth-first, best-first search any many more heuristic techniques. Heuristic functions and their effect on performance of search algorithms.
CO3: Represent the knowledge in different forms as well as an understanding of other topics such as minimax, resolution, etc.
CO4: Learn the different methods of Planning and Learning.

UNIT-I

Overview of A.I: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Criteria for success.

Problems, problem space and search: Defining the problem as a state space search, Production system and its characteristics, Issues in the design of the search problem.

Heuristic search techniques: Generate and test, hill climbing, best first search technique, problem reduction, constraint satisfaction.

UNIT-II

Knowledge Representation: Definition and importance of knowledge, Knowledge representation, various approaches used in knowledge representation, Issues in knowledge representation.

Using Predicate Logic: Represent ting Simple Facts in logic, representing instances and is-a relationship, Computable function and predicate.

UNIT-III

Natural language processing: Introduction syntactic processing, Semantic processing, Discourse and pragmatic processing.

Learning: Introduction learning, Rote learning, learning by taking advice, learning in problem solving, learning from example-induction, Explanation based learning.

UNIT-IV

Expert System: Introduction, Representing using domain specific knowledge, Expert system shells.

TEXT BOOKS

1. Elaine Rich, Kevin Knight: Artificial Intelligence, Tata McGraw Hill.
2. David W. Rolston: Principles of Artificial Intelligence and Expert System Development, McGraw Hill Book Company.

REFERENCE BOOKS

1. D.W. Patterson, Introduction to AI and Expert Systems, PHI, 1999
2. Nils J Nilsson, "Artificial Intelligence -A new Synthesis" 2nd Edition, Harcourt Asia Ltd, 2000.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/
2. https://epgp.inflibnet.ac.in/
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	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)

B.Sc. Mathematics and Computing
SEMESTER VI
Discipline Elective Course (DEC)
CODE: DEMH-601A
SUBJECT NAME: Financial Mathematics
NO OF CREDITS: 6

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
6 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:

Students will be able to

CO1: Calculate simple and compound interest for discrete and continuous cases
CO2: Learn about time value of money, bond prices and yields
CO3: Describe asset return, short selling, portfolio return etc.
CO4: Work on Brownian Motion for stock prices

UNIT –I

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), Interest rates, Present value analysis, Rate of return, continuously varying interest rates

UNIT- II

Time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields, Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds.

UNIT- III

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints), Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen’s index.

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

L T P	INTERNAL ASSESSMENT:	25
6 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:
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	1	2	3	1	3	3	1	2	1	2	3	2	3
CO2	3	2	2	3	1	3	2	1	2	1	3	3	3	3
CO3	3	2	2	3	2	3	2	1	1	1	2	3	2	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
Average	3	2	2	3	1.8	3	2.5	1.25	2	1.25	2.5	3	2.5	3

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

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

	INTERNAL ASSESSMENT: 25
L T P	END SEMESTER: 75
6 0 0	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	1	3	2	2	2	3	2	3	2	3	3	3	3	2
CO2	1	2	3	2	3	3	3	3	2	3	2	3	3	2
CO3	--	3	3	2	3	2	2	2	3	2	--	2	2	3
CO4	2	3	2	2	3	2	3	3	3	3	3	2	3	2
Average	1	2.7	2.5	2	2.7	2.5	2.5	2.75	2.75	2.75	2	2.5	2.75	2.25

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

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

L	T	P
6	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 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 co 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	1	2	2	1	3	1	1	2	1	1	3	2	3
CO2	3	1	2	2	1	3	1	1	2	1	1	3	3	3
CO3	3	1	2	2	2	3	1	1	1	1	1	3	2	3
CO4	3	1	2	2	2	3	2	2	3	2	2	3	3	3
Average	3	1	2	2	1.5	3	1.25	1.25	2	1.25	1.25	3	2.5	3

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