Government General Degree College, Kalna-I

Department of Mathematics

Department wise Course Structure under CCFUP (NEP 2020)

for

Semester-I

(Major Mathematics with Minor Physics)

Semester-I

Course Type	Title of the Course	Credit	Full Marks	Lecture Hour
Major Course **MATH1011**	**Calculus, Geometry &Vector Calculus**	**4** (Theory-04)	**75** (Theory-60, Internal Assessment–15)	**60** (Lecture -45, Tutorial – 15)
Minor Course **PHYS1021**	**Mathematical Physics-I**	**4** (Theory-03, Practical -01)	**75** (Theory-40, Practical-20, Internal Assessment–15)	**75** (Theory-45, Practical-30)
Multi/ Interdisciplinary **ENGL1031**	**Communication Skills**	**3** (Theory-03)	**50** (Theory-40, Internal Assessment–10)	**40** (Lecture -30, Tutorial – 10)
AEC (L1-1 MIL) BENG1041	**Sahityer Bodh O Bichar**	**2** (Theory-02)	**50** (Theory-40, Internal Assessment–10)	**30**
SEC **MATH1051**	**Graph Theory**	**3** (Theory-03)	**50** (Theory-40, Internal Assessment–10)	**45**
Common Value-Added Course	**Environmental Science / Education**	**4** (Theory-04)	**100**	**60**
		Total Credit = 20	**Total Marks = 400**	

MAJOR COURSE

Course Code: MATH1011
Course Name: Calculus, Geometry &Vector Calculus (Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives

To study calculus, geometry and vector calculus

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. higher order derivatives and its applications, concavity of curves, asymptotes and curve tracing techniques.
ii. reduction formula for integration of functions like $\sin nx$, $\sin^m x \sin^n x$ etc., area of surface of revolution, parametric curves etc.
iii. classification of conics and conicoids, polar equation of conics.
iv. vector valued functions and vector calculus.

Skills: The students would be able to

i. parametrize curves, sketch functions and plot them.
ii. visualize standard quadratic surfaces like cone, ellipsoid etc.
iii. apply calculus on vector valued functions.
iv. find gradient of scalar functions, divergence and curl of vector valued functions.

General competence: The students would gain

i. a general idea of advance calculus and its applications.
ii. the idea of solving complex problems using vector calculus and geometry.
iii. analytical and reasoning skills, which improve their thinking power and enhance their problem solving ability.

Contents:

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type

$e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, indeterminate forms, L'Hospital's rule, concavity of curves, points of inflection, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves. **[L-12H& T-4H]**

Reduction formulae, derivations and illustrations of reduction formulae for the integration of $\sin nx$, $\cos nx$, $\tan nx$, $\sec nx$, $(\log x)^n$, $\sin^n x \sin^m x$, parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution. **[L-10H& T-3H]**

Reflection properties of conics, translation and rotation of axes, general equation of second-degree, classification of conics, polar equations of conics, spheres, cylindrical surfaces. central conicoid, paraboloids, plane sections of conicoid, generating lines, classification of quadrics. **[L-11H & T-4H]**

Triple product of vectors, introduction to vector functions, algebraic operations on vector-valued functions, limits and continuity of vector functions, differentiation and partial differentiation of vector functions, gradient of a scalar function, divergence and curl of vector functions. [L-**12H& T-4H]**

Reading References:

Text Books:

1. Calculus - G.B. Thomas and R.L. Finney, 9th Ed., (Pearson Education, Delhi, 2005).
2. Calculus - M.J. Strauss, G.L. Bradley and K. J. Smith, 3rd Ed., (Dorling Kindersley (India) P.Ltd. (Pearson Education), Delhi, 2007).
3. Integral Calculus - K. C. Maity and R. K. Ghosh.,(New Central Book Agency (P) Limited,1999).
4. An Elementary Treatise on Coordinate Geometry of three-Dimensions–R.J.T. Bell,(MacMillan & Co.).
5. The Elements of Coordinate Geometry- S.L. Loney, (MacMillan & Co.).
6. Vector Analysis- K. C. Maity and R. K. Ghosh, (New Central Book Agency (P) Ltd. Kolkata,1999).

Reference Books:

1. Calculus- T. M. Apostol, (Volumes I and II. Vol-I, 1966, Vol-II, 1968).
2. Calculus- H. Anton, I. Bivens and S. Davis, 7th Ed., (John Wiley and Sons (Asia) P. Ltd.,Singapore, 2002).
3. Introduction to Calculus and Analysis - R. Courant and F. John, (Volumes I & II), (Springer-Verlag, New York, Inc., 1989).
4. Analytical Geometry of two and three-dimensions- N. Dutta and R. N. Jana, (ShredharPrakashani).
5. Calculus and Mathematical Analysis- S. Goldberg, 1989.
6. Vector Calculus- J. Marsden, and Tromba, (McGraw Hill, 1987).
7. Schaum's outline of Vector Analysis- M.R. Spiegel, (McGraw Hill, 1980).
8. Vector Analysis with Applications - A. A. Shaikh and S. K. Jana, (Alpha ScienceInternational Ltd., 2009).

MINOR-PHYSICS COURSE

Semester I

MINOR-I: PHYS1021: MATHEMATICAL PHYSICS-I (Credits: Theory-03,Practicals-01)

F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The aim of this course is to equip students with mathematical methods that are important prerequisites for physics courses.

Calculus:

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals. Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Vector Analysis, M R Spiegel, Schaums Outline Series.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Higher Engineering Mathematics, B S Grewal, Khanna Publisher.
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, H K Dass and R Verma, S. Chand & Company Pvt. Ltd.
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press

MINOR-I: PHYS1021: MATHEMATICAL PHYSICS-I

Practical:

COURSE OBJECTIVE: The aim of this course is to learn computer programming and numerical analysis and to emphasize its role in solving problems in Physics.

Topics	**Description with Applications**
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point number algorithms, Sequence, Selection and Repetition, singl and double precision arithmetic, underflow &overflow phasize the importance of making equations in term of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative rors, Floating point computations.
Review of C&C++Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If statement. If else Statement. Nested if Structure. Else if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. For Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects

Programs:

1. Write and execute a program in C/C++ to sort elements of an array of Seven elements in ascending order.

2.Write and execute a program in C/C++ to find the area and volume of a Sphere by varying the dius.

3. Write and execute a program in C/C++ to find the value of Sine function using power series (The argument will be given during execution)

4. Write and execute a program in C/C++ to find the value of e^x (x will be given during execution of the program).

5. Write and execute a program in C/C++ to compute the factorial of a positive integer including Zero.

6. Write and execute a program in C/C++ to calculate sum of squares of n natural numbers.

7. Write and execute a program in C/C++ to separate odd and even integers in arrays.

8. Write and execute a program in C/C++ to find the value of Cosine function using power series (The argument will be given during execution)

9. Write and execute a program in C/C++ to sort elements of an array of Six elements in descending order.

10. Write and execute a program in C/C++ to calculate value of π.

11. Write and execute a program in C/C++ to find the largest and smallest in a given set of numbers.

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study theoretical and experimental physics.

Reference Books

1. IntroductiontoNumericalAnalysis,S.S.Sastry,5thEdn.,2012,PHILearningPvt.Ltd.
2. Schaum'sOutlineofProgrammingwithC++.J.Hubbard,2000,McGraw-HillPub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn., 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M.Ascher&C.Greif,2012,PHI Learning.
5. ElementaryNumericalAnalysis,K.E.Atkinson,3rdEdn.,2007,WileyIndiaEdition.
6. AnIntroductiontocomputationalPhysics,T.Pang,2ndEdn.,2006,CambridgeUniv. Press
7. ComputationalPhysics,DarrenWalker,1stEdn.,2015,ScientificInternationalPvt. Ltd.
8. Programming in ANSI C, E Balagurusamy, McGraw Hill Education.
9. Object Oriented Programming with C++, E Balagurusamy, McGraw Hill Education.
10. Let Us C, Y Kanetkar, BPB Publications.

INTERDISCIPLINARY COURSE 1

Communication Skills

Introduction to Communication Skills

Listening:

listening to casual conversations; listening to lectures; listening to instructions; listening to theatrical or movie dialogues; listening to news bulletins

Speaking:

speaking during casual conversations; speaking to a gathering; delivering a formal speech; offering instructions / advice; speaking as a presenter on television and radio; speaking during group discussions; speaking while facing an interview board

Reading:

Reading for pleasure; reading for examinations; reading for research; reading in a group; reading newspapers

Writing:

Writing formal letters; writing emails; writing messages on social media; writing for popular magazines; report writing for newspapers; feature writing for newspapers; writing a resume, writing applications for jobs, writing memos

4. AEC (L1-1 MIL) সাহিত্যের বোধ ও বিচার BENG1041

Course Title: সাহিত্যের বোধ ও বিচার

Course Code: 4

Course Credit: 2

Course Lecture Hour: 30

Objective of the Course: এই কোর্সের উদ্দেশ্য ভাষা এবং সাহিত্য বোধ ও সাহিত্য বিচারের প্রাথমিক ধারণা দেওয়া। কোনো সাহিত্যিক নিদর্শনকে শিক্ষার্থী তার বোধ ও বিচারশক্তি দিয়ে কীভাবে আয়ত্ত করতে পারে, সেটাই এই কোর্সে তাকে শেখানো হবে।

একক ১: ভাষা অংশ (Lecture Hour: 10)

ক. বোধপরীক্ষা: (নিম্নলিখিত পাঁচটি প্রবন্ধ পাঠ্য)

১. স্বদেশী সমাজ – রবীন্দ্রনাথ ঠাকুর

২. বাঙ্গালা ভাষা – স্বামী বিবেকানন্দ

৩. বই পড়া – প্রমথ চৌধুরী

৪. স্ত্রী জাতির অবনতি – বেগম রোকেয়া

৫. অপবিজ্ঞান – রাজশেখর বসু

একক ২: সাহিত্য অংশ (Lecture Hour: 20)

ক. কবিতার ভাবসৌন্দর্য বিশ্লেষণ

রবীন্দ্রনাথ ঠাকুরের নৈবেদ্য গ্রন্থের চারটি কবিতা পাঠ্য - (বৈরাগ্যসাধনে মুক্তি সে আমার নয়, শতাব্দীর সূর্য আজি, চিত্ত যেথা ভয়শূন্য, শক্তি দম্ভ স্বার্থ লোভ)

খ. ছোটোগল্পের শিল্পসার্থকতা বিচার

রবীন্দ্রনাথ ঠাকুরের গল্পগুচ্ছ থেকে তিনটি গল্প পাঠ্য – ছুটি, বলাই, মণিহারা

Outcome of the Course: এই কোর্স পড়ার পর শিক্ষার্থী সাহিত্যের বিষয় অনুধাবনের পাশাপাশি তার শিল্পসার্থকতা ও ভাবসৌন্দর্য বিশ্লেষণ করতে শিখল।

SEC-1:MATH1051: GRAPH THEORY (Credits:03)

F.M.=50 (Theory-40, Internal Assessment–10)

Objectives: To study the basics of Graph theory and its applications.

Learning outcomes: On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence: Knowledge: The students would gain knowledge about

i. undirected and directed graphs.
ii. ismorphism of graphs.
iii. Eulerian graphs, Hamiltonian graphs.
iv. various characterizations of trees with applications.
v. bipartite graph and its characterization.
vi. planar and non-planar graphs.
vii. colouring of a graph.
viii. matrix representation of graphs.

Skills: The students would be able to
i. assimilate various graph theoretic concepts and familiarize with their applications.
ii. efficiency in handling with discrete structures.
iii. efficiency in notions of matrix representation of graph, planarity.
iv. efficiency in solving concrete graph colouring problems.
v. solve real world problems that can be modelled by graphs.

General competence: The students would gain
i. general idea of graph theory and its real-life applications.
ii. understanding about graphic sequence.
iii. experience to apply Euler's formula.
iv. ability to use graphs for various map colouring problems.
v. idea about the application of graphs in computer science.

Contents: Definition, examples and basic properties of graphs, complete graphs, Havel-Hakimi theorem (Statement and its application), bi-partite graphs, isomorphism of graphs.[L-8H & T-3H] Königsberg bridge problem, Eulerian graph, Hamiltonian graph, Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph.[L-9H & T-3H] Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm. [L-9H & T-3H] Planar and non-planar graphs, Euler's formula, colouring of graphs, four colour problem, five colour theorem. [L-4H & T-1H]

Reading references:

Text Books:

1. Graph Theory-N. S. Deo, (Prentice-Hall, 1974).
2. Introduction to Graph Theory - D. S. Malik, M. K. Sen & S. Ghosh, (Cengage Learning Asia, 2014).

Reference Books:

1. A First Look at Graph Theory - J. Clark & D. A. Holton, (Allied Publishers Ltd., 1995).
2. Introduction to Graph Theory- Douglas Brent West, (Prentice Hall, 2001).
3. Graph Theory- Frank Harary, (Addison-Wesley, 1971).
4. Graph Theory with Applications- J. A. Bondy & U.S.R. Murty, (Macmillan, 1976).

SEMESTER- I
Value Added
Course (VAC)
Course Code:
CVA1061, FM 100

COURSE TITLE: ENVIRONMENTAL SCIENCE / EDUCATION

Learning objectives

- To create awareness and understanding of the environment and its different components
- To get knowledge on different current environmental problems and issues in national and international levels
- To impart knowledge about the management practices of different environmental problems
- To get real life experiences of different environmental resources, ecosystems and environmental degradation

Unit 1: Basics of Environmental Studies: **(05)**

Definition, Nature, Scope and Importance; Components of environment: Environmental education

Unit 2: Natural Resources: Renewable and Nonrenewable Resources **(10)**

Nature and natural resources their conservation and associated problems:

- Forest resources: Uses, types and importance, Joint Forest Management & symbiotic relationship betweentribal population and forests, Deforestation and its effects
- Water resources: Distribution of water on Earth; Use, over exploitation of surface and ground water; Dams:Benefits and problems; Flood and Drought
- Mineral resources: Mineral resources in India; Use and exploitation, Social impacts of mining
- Food resources: World food problems and food insecurities.
- Energy resources: Renewable and Nonrenewable energy sources; Use of alternate energy sources - Case studies
- Land resources: Land as a resource; Land degradation, landslides, soil erosion, desertification
- Use of resources for sustainable development (Concepts & Goals)

Unit 3: Ecology and Ecosystems **(08)**

- Concept of ecology, Population ecology, Community ecology
- Concept of an ecosystem, different types of ecosystem
- Food chains, food webs and ecological succession
- Energy flow in the ecosystem and energy flow models

Unit 4: Biodiversity and its conservation **(08)**

Biodiversity: Levels of biological diversity

- Values of biodiversity
- Hot-Spots of biodiversity, IUCN Red Data Book, Mega-biodiversity countries
- Threat to biodiversity
- Threatened and endemic species of India
- Conservation of biodiversity (In- situ and Ex-situ)
- Ecosystem services: Ecological, Economic, Social, Ethical, Aesthetical and Informational values

Unit 5: Environmental Pollution and Management **(08)**

a) Nature, Causes, Effects and Control measures of – Air pollution, Water pollution, Soil pollution, Noisepollution

b) Solid waste management: Causes, effects and disposal methods; Management of biomedical and municipalsolid wastes

c) Disaster management: Floods, Earthquake, Droughts, Cyclone and Landslides

Unit 6: Environmental Policies and Practices **(10)**

Constitutional Provisions for protecting environment- Article 48(A), 51A(g)

- Environmental Laws: The Environment (Protection) Act, 1986; The Air (Prevention and Control of Pollution)Act, 1981; The Water (Prevention and Control of Pollution) Act 1974; Forest (Conservation) Act, 1980
- The wildlife Protection Act, 1972
- Climate change, Global warming, ENSO, Acid rain, Ozone layer depletion; Montreal and Kyoto Protocols

Unit 7: Human Communities and Environment **(06)**

- Human population growth; Impacts on environment
- Environment and human health: Concept of health and disease; Common communicable and Non-communicable diseases; Health awareness programmes in India
- Environment movements in India: Chipko Movements, Silent Valley Movement, Narmada Banchao Aandolan

Unit 8: Field Work Report/Project Report/Term paper Marks: 20

[Based on any one of the following topics and to be evaluated by internal teachers only]

- Environmental assets - River/Forest/Grassland/Hill/Mountain etc.
- Environmental pollution - Urban/Rural/Industrial/Agricultural
- Study of common Plants/Insect /Birds/Wild life etc.
- Study of simple ecosystems: Pond/River/Hill slope etc.

- **Learning outcomes**
  - Understanding on environment and its importance
  - Knowledge on different natural resources, causes of depletion and its sustainable uses
  - Understanding the significance of biodiversity and its conservation
  - Ideas on provisions of Indian Constitution for environmental protection
  - Understanding the interrelationship among human population growth, environment and human health
  - Knowledge of on-field experience on environmental issues through project work.

LESSON PLAN

Semester: I

Subject: Mathematics Major

MATH1011 (Calculus, Geometry and Vector Calculus)

Total Lectures = 60

Unit- 1	**Total Lecture Hours =16 (Lecture 12 + Tutorial 04)**
CONTENTS	
Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$ concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.	
Lecture Serial	**Topics of Discussion**
Lecture 1	Brief discussion on continuity, differentiability: Definition, examples and some results.
Lecture 2	Hyperbolic functions, higher order derivatives.
Lecture 3	Statement and proof of Leibnitz rule, examples.
Lecture 4	Applications of Leibnitz rule to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$.
Lecture 5	Concavity and inflection points. Examples.
Lecture 6	Envelopes.
Lecture 7	Asymptotes.
Lecture 8	Curve tracing in Cartesian coordinates of standard curves.
Lecture 9	Curve tracing in polar coordinates of standard curves.
Lecture 10	L'Hospital's rule discussion.
Lecture 11	Applications of derivatives in real world problems
Lecture 12	Discussion of more problems.
Lecture 13	Tutorial
Lecture 14	Tutorial
Lecture 15	Tutorial
Lecture 16	Tutorial
Unit- 2	**Total Lecture Hours =13 (Lecture 10 + Tutorial 03)**
CONTENTS	
Reduction formulae, derivations and illustrations of reduction formulae for the integration of $\sin nx$, $\cos nx$, $\tan nx$, $\sec nx$, $(\log x)^n$, $\sin^n x \sin^m x$, parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution .Techniques of sketching conics	
Lecture 17	General discussion on indefinite and definite integration and simple problems.
Lecture 18	Simple concept on reduction formula. Simple problems.
Lecture 19	Derivation and illustrations of reduction formulae for $\sin nx$, $\cos nx$ and applications.

Lecture 20	Derivation and illustrations of reduction formulae for tan nx, sec nx and applications.
Lecture 21	Derivation and illustrations of reduction formulae $(\log x)^n$, $\sin^n x \sin^m x$ and applications.
Lecture 22	Parametric equations, parametrizing a curve. Examples
Lecture 23	Arc length, arc length of parametric curves and examples.
Lecture 24	Area of surface of revolution.
Lecture 25	More problems on area of surface of revolution.
Lecture 26	Techniques of sketching conics
Lecture 27	Tutorial
Lecture 28	Tutorial
Lecture 29	Tutorial
Unit- 3	**Total Lecture Hours =15 (Lecture 11 + Tutorial 04)**
CONTENTS Reflection properties of conics, translation and rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics. Spheres.Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	
Lecture 30	Reflexion properties of conics, translation and rotation of axes with examples
Lecture 31	Invariants and some problems
Lecture 32	General equation of 2^{nd} degree: Classification and canonical forms of conics
Lecture 33	Polar equation of conics : Equations of straight line, circle, conic
Lecture 34	Polar equation of conics : Some problems
Lecture 35	Spheres: Some basic properties and problems
Lecture 36	Some more problems on sphere
Lecture 37	Cylindrical surface and central conicoids, ellipsoid, hyperboloid and paraboloid
Lecture 38	Generating lines: Properties and problems
Lecture 39	General equation of 2^{nd} degree in three variables
Lecture 40	Some more problems determining nature and canonical forms of conics in 3D
Lecture 41	Tutorial
Lecture 42	Tutorial
Lecture 43	Tutorial
Lecture 44	Tutorial

Unit- 4	**Total Lecture Hours =16 (Lecture 12 + Tutorial 04)**
CONTENTS Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions	
Lecture 45	Preliminary idea about product of vectors, product of three and four vectors, geometrical interpretation of scalar and vector triple product.
Lecture 46	Discussion of some elementary geometrical problem by application of vector method, coplanarity of three vectors etc.
Lecture 47	Discussion of problems on triple product, application of vectors in mechanics.
Lecture 48	Introduction to vector functions, definition of vector function and example of different kinds of vector valued functions.
Lecture 49	Algebra of vector-valued functions, examples.
Lecture 50	Definition of limit for a vector valued function, algebra of limits and examples.
Lecture 51	Definition of continuity for a vector valued function, algebra of continuous vector functions and examples.
Lecture 52	Definition of differentiability for a vector valued function, algebra of differentiable vector functions and examples.
Lecture 53	Integration of vector functions: Definition, discussion of some properties and evaluation of integration of vector valued function.
Lecture 54	Gradient of Scalar functions with examples, Directional Derivatives
Lecture 55	Divergence of vector functions and solenoidal vectors
Lecture 56	Curl of vector functions and irrotational vectors
Lecture 57	Tutorial
Lecture 58	Tutorial
Lecture 59	Tutorial
Lecture 60	Tutorial

Departmental Continuous Internal Evaluation (CIE) Structure				
Type of Evaluation	Assignment	Project	MCQ	Viva Voce
Marks Allotted	10	10	10	10

Lesson Plan
for
B.Sc. Semester-I
Subject: Physics
Paper Name: Mathematical Physics-I
Paper Code: Minor-I: PHYS1021

Credits: Theory-03, Practicals-01
F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The aim of this course is to equip students with mathematical methods that are important prerequisites for physics courses.

Module-I **Calculus**
Contents Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.
Module Objectives: 1. Recapitulation of function, limit and continuity 2. To know the methods of solving the first order and second order differential equation. 3. To know the methods of solving the partial differential equation.

Lecture Serial	Topics of Discussion
Lecture-1	**Function:** Limits, continuity, average and instantaneous quantities, differentiation.
Lecture-2	**Function Plot:** Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves.
Lecture-3	**Approximation Method:** Taylor and binomial series
Lecture-4	**Nature of Differential Equations:** Definition of differential equation. Representation of differential equation. Ordinary differential equation, Degree of a differential equation, Partial differential equation.

Lecture-5	**First Order Differential Equation:** Definition, Linear Equations, Bernoulli Equations, Homogeneous Equation, Some examples on 1st order homogeneous equation.
Lecture-6	**Exact Differential Equation:** Condition for exact differential equation, Some examples regarding exact differential equation.
Lecture-7	**Inexact Differential Equation:** Integrating factor, Some examples related to inexact differential equation.
Lecture-8	**Second Order Differential Equations:** Homogeneous equation and non-homogeneous equation. Definition of Wronskian, Some problems regarding Wronskian.
Lecture-9	**Second Order Differential Equations:** The use of a known solution to find a another solution. Homogeneous equation with constant coefficients.
Lecture-10	**Second Order Differential Equations:** Nonhomogeneous second order differential equation, The method of undetermined coefficients.
Lecture-11	**Second Order Differential Equations:** Vibration in mechanical system.
Lecture-12	**Operator Method:** Particular solution of first and second order liner equations.
Lecture-13	**Particular Integrals:** Properties of particular integrals. Some examples regarding the particular integrals.
Lecture-14	**Existence and Uniqueness Theorems:** Statements and some examples of initial value problem.
Lecture-15	**Partial derivatives:** Exact and inexact differentials.
Lecture-16	**Partial derivatives: I**ntegrating factor, with simple illustration.
Lecture-17	**Lagrange Multipliers:** Constrained Maximization using Lagrange Multipliers.
Lecture-18	**Lagrange Multipliers:** Some examples regarding lagrange multipliers.

Tutorial Assignment—I

Module-II **Vector Calculus**
Contents Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals. Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs)

Module Objectives:
1. This module delivers idea about dot and cross products of vectors and their significance And one can understand the laws of vector algebra to solve various problems associated with Vectorcalculus. 2. This unit gives the students idea about vector differentiation 3. One can get knowledge about Gradient of scalar field, Divergence and curl of a vector field and their significance. 4. This unit enables the student to solve various problems associated with vector differentiation 5. This unit delivers idea about vector integration, both ordinary and multiple integration. 6. This unit enables the student to solve various problems associated with vector line, surface and volume integration. 7. One can also get knowledge about Vector Theorems and can apply them to solve various problems on vector integration.

Lecture Serial	Topics of Discussion
Lecture-19	**Introduction to Vector:** Vector definition, unit vector, polar and axial vector, Properties of vectors under rotations.
Lecture-20	**Product of Vectors:** Product of two vectors, Scalar product and its invariance under rotations. Vector product, Significance of dot and cross product.
Lecture-21	**Vector Product:** Scalar triple product and their interpretation in terms of area and volume respectively. Vector triple product.
Lecture-22	**Laws of vector algebra:** Properties of dot and cross product.
Lecture-23	**Scalar and Vector fields and Vector Derivatives:** Defination, Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation.
Lecture-24	**Divergence of a vector field:** Defination, Some example regarding divergence, Physical significance of divergence of a vector field.
Lecture-25	**Curl of a vector field:** Defination, Some example regarding curl, Physical significance of curl of a vector field.
Lecture-26	**Vector Operator:** Del and Laplacian operators. Vector identities.
Lecture-27	**Vector Operator:** Some examples regarding vector operator
Lecture-28	**Vector Integrals:** Ordinary Integrals of Vectors. Multiple integrals, Jacobian and its apllications.
Lecture-29	**Line Integrals:** Conservative vector field and scaler potential
Lecture-30	**Line Integrals:** Few instances regarding line integrals.
Lecture-31	**Surface Integrals:** Basic theory on surface integrals.
Lecture-32	**Surface Integrals:** Some examples regarding vector integrals
Lecture-33	**Surface Integrals:** Few instances regarding vector integrals
Lecture-34	**Volume Integrals:** Basic theory on volume integrals. Some example on volume integrals.
Lecture-35	**Green's Theorem:** Green's theorem in the plane. Discuss some exapmles.
Lecture-36	**Stokes' Theorem:** Statement of Stokes theorem. Application of Stokes' theorem.

Lecture-37	**Stokes' Theorem:** Verification of Stokes theorem.
Lecture-38	**Gauss' divergence theorem:** Statement of Gauss' theorem and its physical significant. Application of divergence theorem.
Lecture-39	**Few more Intergral Theorem:** Application of Stokes' and Gauss' divergence theorem.

Tutorial Assignment—II

Module-III **Orthogonal Curvilinear Coordinates**
Contents Orthogonal Curvilinear Coordinates: Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.
Module Objectives: 1. To understand the generalized coordinate system. 2. To learn and apply techniques of orthogonal curvilinear coordinate system in cylindrical and spherical coordinate system.

Lecture Serial	Topics of Discussion
Lecture-40	**Curvilinear Coordinates:** Unit Vector in Curvilinear coordinate system, Arc length and Volume elements
Lecture-41	**Differential operators:** Gradient of a scalar in orthogonal curvilinear coordinates.
Lecture-42	**Differential operators:** Divergence of a vector in orthogonal curvilinear coordinates, Laplacian operator.
Lecture-43	**Differential operators:** Curl of a vector in orthogonal curvilinear coordinates
Lecture-44	**Spherical Polar Coordinate:** Differential operators in terms of spherical coordinate.
Lecture-45	**Cylindrical Coordinate system:** Differential operators in terms of cylindrical coordinate.

Tutorial Assignment—III

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study theoretical and experimental physics.

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Vector Analysis, M R Spiegel, Schaums Outline Series.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

5. Higher Engineering Mathematics, B S Grewal, Khanna Publisher.
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, H K Dass and R Verma, S. Chand & Company Pvt. Ltd.
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press

Practical

COURSE OBJECTIVE: The aim of this course is to learn computer programming and numerical analysis and to emphasize its role in solving problems in Physics.

Contents

Introduction and Overview: Computer architecture and organization, memory and Input/output devices

Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow
emphasize the importance of making equations in terms of dimensionless variables, Iterative methods

Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations.

Review of C&C++Programming fundamentals: Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If statement. If else Statement. Nested if Structure. Else if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. For Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects

Programs:
1. Write and execute a program in C/C++ to sort elements of an array of Seven elements in ascending order.
2. Write and execute a program in C/C++ to find the area and volume of a Sphere by varying the radius.
3. Write and execute a program in C/C++ to find the value of Sine function using power series (The argument will be given during execution)
4. Write and execute a program in C/C++ to find the value of e x (x will be given during execution of the program).
5. Write and execute a program in C/C++ to compute the factorial of a positive integer including Zero.
6. Write and execute a program in C/C++ to calculate sum of squares of n natural numbers.
7. Write and execute a program in C/C++ to separate odd and even integers in arrays.
8. Write and execute a program in C/C++ to find the value of Cosine function using power series

(The argument will be given during execution)
9. Write and execute a program in C/C++ to sort elements of an array of Six elements in assending order.
10. Write and execute a program in C/C++ to calculate value of π.
11. Write and execute a program in C/C++ to find the largest and smallest in a given set of numbers.

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study theoretical and experimental physics.

Reference Books:

1. IntroductiontoNumericalAnalysis,S.S.Sastry,5thEdn.,2012,PHILearningPvt.Ltd.
2. Schaum'sOutlineofProgrammingwithC++.J.Hubbard,2000,McGraw-HillPub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn., 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M.Ascher&C.Greif,2012,PHI Learning.
5. ElementaryNumericalAnalysis,K.E.Atkinson,3rdEdn.,2007,WileyIndiaEdition.
6. AnIntroductiontocomputationalPhysics,T.Pang,2ndEdn.,2006,CambridgeUniv. Press
7. ComputationalPhysics,DarrenWalker,1stEdn.,2015,ScientificInternationalPvt. Ltd.
8. Programming in ANSI C, E Balagurusamy, McGraw Hill Education.
9. Object Oriented Programming with C++, E Balagurusamy, McGraw Hill Education.
10. Let Us C, Y Kanetkar, BPB Publications.

LESSON PLAN

Semester : I

Subject : Mathematics

Paper : MATH1051 (Graph Theory)

Total Lecture Hours = 40(L-30, T-10)

Unit 1	***Total Lecture Hours =11 (08 Lectures+03 Tutorials)***
Lecture Serial	**Topics of Discussion**
Lecture 1	Some basic definitions like vertex, edges etc. with examples
Lecture 2	Some basic properties related to vertices and edges of graph and their examples
Lecture 3	Concept of Pseudo graph with examples and problems
Lecture 4	The idea of complete graph and examples
Lecture 5	Some theorems, examples and problems of complete graph
Lecture 6	Connected and Bi-partite graphs: Definition and some examples and some theorems
Lecture 7	Some more theorems and problems on bi-partite graphs
Lecture 8	The concept of isomorphism between two graphs with Examples and problems
Lecture 9	Tutorial
Lecture 10	Tutorial
Lecture 11	Tutorial

Unit 2	***Total Lecture Hours =12 (09 Lectures+03 Tutorials)***
Lecture Serial	**Topics of Discussion**
Lecture 12	The introduction of Konigsberg's bridge problem and the origin of graph theory
Lecture 13	Definition of Eulerian circuits and Eulerian graphs with examples
Lecture 14	Some theorems and problems on Eulerian graph and the conclusion of the Konigsberg's bridge problem.

Lecture 15	Definition of Hamiltonian cycles and Hamiltonian graph with examples
Lecture 16	Some theorems and examples of Hamiltonian graph
Lecture 17	The relation and comparing between Eulerian graph and Hamiltonian graph with examples
Lecture 18	The adjacence matrix with examples and some properties
Lecture 19	The incidence matrix of a graph with examples and some properties
Lecture 20	Concept of weighted graph with some examples
Lecture 21	Tutorial
Lecture 22	Tutorial
Lecture 23	Tutorial

Unit 3	***Total Lecture Hours =12 (09 Lectures+03 Tutorials)***
Lecture Serial	**Topics of Discussion**
Lecture 24	Definitions and examples of Tree
Lecture 25	Some more definitions, theorems on Tree
Lecture 26	Some more results and problems on Tree
Lecture 27	Definition of spanning tree and examples
Lecture 28	Some theorems and examples of tree and spanning tree
Lecture 29	The concept of Travelling sale's man problem of shortest path
Lecture 30	Dijkstra's algorithm and it's application to find shortest path
Lecture 31	Some more problems of finding shortest path
Lecture 32	Warshall algorithm for finding shortest path between all the pair of vertices in a weighted graph
Lecture 33	Tutorial
Lecture 34	Tutorial
Lecture 35	Tutorial

Unit 4	***Total Lecture Hours =05 (04 Lectures+01 Tutorials)***
Lecture Serial	**Topics of Discussion**
Lecture 36	Planar & Non-planar graph
Lecture 37	Euler's Formula
Lecture 38	Colouring of graphs
Lecture 39	Four Colour Theorem & Five Colour conjecture
Lecture 40	Tutorial

Departmental Continuous Internal Evaluation (CIE) Structure				
Type of Evaluation	Assignment	Project	MCQ	Viva Voce
Marks Allotted	10	10	10	10