Under-Graduate Programme

Allied Mathematics Courses
(Physics)

Courses of Study, Schemes of Examinations
& Syllabi
(Choice Based Credit System)

THE DEPARTMENT OF MATHEMATICS
(DST – FIST sponsored)
BISHOP HEBER COLLEGE (Autonomous)
(Reaccredited with 'A' Grade (CGPA – 3.58/4.0) by the NAAC &
Identified as College of Excellence by the UGC)
DST – FIST Sponsored College &
DBT Star College
TIRUCHIRAPPALLI – 620 017
TAMIL NADU, INDIA

2020 – 2021

Allied Mathematics Courses offered to students of Under Graduate Programme in Physics

(For the candidates admitted from the year 2020 onwards)

Sem.	Course	Code	Title	Hrs./ week	Credits	Marks		
						CIA	ESA	Total
I	I	U20MAY11	Algebra, Calculus and Analytical Geometry of 3D	5	4	25	75	100
II	II	U20MAY22	Vector Calculus and Trigonometry	4	4	25	75	100
II	III	U20MAY23	Differential Equations, Laplace Transforms and Fourier Series	4	4	25	75	100

Allied Course I – Algebra, Calculus and Analytical Geometry of Three Dimensions

Sem. I **Code : U20MAY11**
Total Hrs. . 75 **Credits: 4**

General objectives:

On completion of this course, the learner will

1. know the properties of Eigen values, Eigen vectors and the applications of characteristic equations.
2. be able to understand higher order differentiation and to know the applications of differential calculus.
3. know properties of definite integrals and methods of integration of higher powers of trigonometric functions using recurrence relations.
4. be able to understand properties of straight lines and spheres with reference to three dimensional co-ordinate geometry.

Learning outcomes:

On completion of the course, the student will be able to

1. find the eigen values, eigen vectors of a given matrix.
2. find higher derivatives of given functions.
3. be able to understand properties of straight lines and spheres.

Algebra

Unit I

Eigen values and Eigen vectors - Cayley - Hamilton theorem – Diagonalisation of matrices.

Calculus

Unit II

Leibnitz ' s formula for n^{th} derivative of a product – Curvature and radius of Curvature – Cartesian formula for radius of curvature.

Unit III

Properties of Definite Integrals – Reduction Formulae for $\int e^{ax}x^n dx, \int \sin^n x\, dx, \int \cos^n x\, dx,$ where n is a positive integer – Evaluation of $\int_0^\infty e^{-ax}x^n dx, \int_0^{\frac{\pi}{2}} \sin^n x\, dx, \int_0^{\frac{\pi}{2}} \cos^n x\, dx,$ where n is a positive integer.

Analytical Geometry of Three Dimensions

Unit IV

Straight line – equation of a straight line – condition for a straight line to lie on a given plane – condition for coplanarity – shortest distance between two straight lines.

Unit V

Sphere – standard equation – length of the tangent from any point – Equation of a tangent plane – condition for the plane to touch the sphere – intersection of a plane and a sphere – intersection of two spheres – Equation of a sphere passing through a given circle.

Text Books

1. Dr P Mariappan, Dr V Franklin and Others, Algebra, Calculus and Analytical Geometry of 3D, 1st Edition, New Century Book House, Pvt. Ltd, Chennai.

Unit I	Chapter 1
Unit II	Chapter 2
Unit III	Chapter 3
Unit IV	Chapter 5
Unit V	Chapter 5

References

1. T.K. Manichavasagam Pillai, T. Natarajan and K.S. Ganapathy, Algebra (Vol.II), S. Viswanathan Pvt. Ltd, Reprint,2004.
2. S. Narayanan and T.K. Manichavasagam Pillay, Calculus (Vol-I, II), S. Viswanathan Printers and Publishers, Reprint,2003.
3. Vittal. P. R, Allied Mathematics, Margham Publications, Chennai, Reprint 2000.
4. M.K. Venkataraman, Engineering Mathematics, National Publishing Company, 1999.

Allied Course II – Vector Calculus and Trigonometry

Sem. II **Code : U20MAY22**
Total Hrs. 60 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. know the physical applications of derivatives of vectors especially the divergence and curl.
2. be able to understand line integral, surface integral and volume integral, to know their inter-relations and their applications.
3. know the expansions of circular and hyperbolic functions and their powers.

Learning outcomes:

On completion of the course, the student will be able to

1. find derivatives of vector functions.
2. evaluate line, surface and volume integrals.
3. expand circular functions as a series.
4. evaluate limits of combination of trigonometric functions.

Vector Calculus

Unit I

Scalar and Vector Point Functions - Direction and Magnitude of gradient - Maximum Value of Directional derivative - Divergence and Curl - Definitions (Solenoidal and Irrotational Vectors) - Vector Identities - Formula involving Operator ∇ twice.

Unit II

Vector integration – Line integral – Surface integral – Volume integral

Unit III

Verification of Gauss divergence theorem- Stoke's theorem –Green's theorem (in plane), (No proof is needed)

Trigonometry

Unit IV

Expansions for $sinn\theta$, $cosn\theta$,$tann\theta$ when n is a positive integer- Expansion for $tan(\theta_1 + \theta_2 + \cdots \theta_n)$ –Expansions for $cos^n\theta$ and $sin^n\theta$in terms of multiples of θ – Expansions of $sin\theta$ and $cos\theta$in terms of θ - Expansion of $tan\theta$.

Unit V

Euler's formula – Hyperbolic functions- Relations between circular and hyperbolic functions- Inverse hyperbolic functions $sinnh^{-1}x$, $cosh^{-1}x$, and $tanh^{-1}x$ in terms of logarithmic functions – Separation into real and imaginary parts of $sin(x+iy), cos(x+iy), tan(x+iy), sinh(x+iy), cosh(x+iy),$ $tanh(x+iy)$ and $tan^{-1}(x+iy)$.

Text Book

1. Dr P. Mariappan, Dr A Emimal Kanaga Pushpam and Others, Vector Calculus and Trigonometry, New Century Book House, Pvt.Ltd, Chennai.

Unit I	Chapter 1
Unit II	Chapter 2
Unit III	Chapter 3
Unit IV	Chapter 4
Unit V	Chapter 5

References

1. S. Narayanan, T.K. Manichavasagam Pillai, Ancillary Mathematics Vol.III, S. Viswanathan Pvt. Ltd, Reprint 1999.
2. S. Narayanan, T.K. Manichavasagam Pillai, Trigonomety, S. Viswanathan Pvt. Ltd, Reprint 2004.
3. P. Duraipandian, Laxmi Duraipandian and Jayamala Paramasivan, Trigonomety, Emerald Publishers, Reprint 1999.

Allied Course – III Differential Equations, Laplace Transforms and Fourier Series

Sem : II **Code : U20MAY23**
Total Hrs. : 60 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. know methods of solving differential equations of one dimension and higher dimension.
2. know application of Laplace transforms in solving ordinary differential equations.
3. be able to understand periodic functions through circular functions as Fourier series.

Learning outcomes:

On completion of the course, the student will be able to

1. classify and solve specific types of ordinary and partial differential equations.
2. solve differential and integral equations using Laplace transforms.
3. find Fourier series of a given periodic function.

Differential Equations

Unit I

Ordinary Differential Equations – First Order and Higher Degree – Equation solvable for $\frac{dy}{dx}$ - Equation solvable for y – Equation solvable for x (simple problems only) – Clairaut 's Form (simple case only).

Unit II

Derivation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions – classification of Integrals – some standard types of First Order Partial Differential Equations – Other standard forms.

Laplace Transforms

Unit III

Definition - Condition for the existence of the Laplace Transforms-Properties of Laplace Transforms - Laplace Transform of some standard functions – Some general theorems.

Unit IV

The Inverse Laplace Transform – Shifting theorem for Inverse Transform – The method of partial fraction can be used to find the Inverse transform of certain functions – Related theorems – Special cases- Applications to solutions of Differential Equations.

Fourier Series

Unit V

Definition – To determine the values of a_0,a_n and b_n – Bernoulli's Formula – Sufficient conditions for representing f(x) by Fourier Series – Even and Odd functions – Properties of Odd and Even functions – Fourier Series of even and odd functions – Half range Fourier Series.

Text Book

1. Dr R Gethsi Sharmila, Dr R Janet and Others, Differential Equations, Laplace Transforms and Fourier Series, New Century Book House, Pvt. Ltd, Chennai.

Unit I	Chapter 1
Unit II	Chapter 2
Unit III	Chapter 3
Unit IV	Chapter 4
Unit V	Chapter 5

References

1. S. Narayanan, T.K. Manichavasagam Pillai, Calculus Volume III, S. Viswanathan Pvt. Ltd, Reprint 2004.
2. Vittal. P. R, Allied Mathematics, Margham Publications, Chennai, Reprint 2000.