# SYLLABUS & PROGRAMME STRUCTURE

# Physics

**(Honours)**

**(Choice Based Credit System)**

(Effective from the Academic Session 2017-2018)

**First Semester**


**MAHARAJA BIR BIKRAM UNIVERSITY**

**AGARTALA, TRIPURA: 799004**

**PROGRAMME STRUCTURE**

## Structure of Proposed CBCS Syllabus B.A/B.Sc/B.Com Honours.

| Semester | Core Course (14) Honours | Ability Enhancement Compulsory Course (AECC) (2) | Skill Enhancement Course (SEC) (2) | Discipline Specific Elective (DSE) (4) | Generic Elective (GE) (4) |
|---|---|---|---|---|---|
| **1** | **C1**<br>**C2** | **AECC1: Environmental Science** | | | **GE1**<br>(Paper-I of selected subject other than Hons subject) |
| **2** | **C3**<br>**C4** | **AECC2 : (English/MIL (Communication)** | | | **GE2**<br>(Paper-II of selected subject other than Hons subject) |
| **3** | **C5**<br>**C6**<br>**C7** | | **SEC1** | | **GE3**<br>(Paper-III of selected subject other than Hons subject) |
| **4** | **C8**<br>**C9**<br>**C10** | | **SEC2** | | **GE4**<br>(Paper-IV of selected subject other than Hons subject) |
| **5** | **C11**<br>**C12** | | | **DSE1**<br>**DSE2** | |
| **6** | **C13**<br>**C14** | | | **DSE3**<br>**DSE4** | |

# First Semester
# Core Course - Paper- I
## MATHEMATICAL PHYSICS – I

TOTAL MARKS – 100
(Theory – 70, Practical-30)

### Unit-I Calculus (15 Lectures)

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.

### Unit-II Vector Calculus-I (15 Lectures)

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.

### Unit-III Vector Calculus-II & Dirac Delta function (15 Lectures)

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).

**Dirac Delta function and its properties**:
Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

### Unit –IV Orthogonal Curvilinear Coordinates & Probability (15 Lectures)

**Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.
**Introduction to probability**:
Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.
Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.

**Reference Books:**


- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Mathematical Physics, Goswami, 1st edition, Cengage Learning
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press


# Practical

## *Basics of scientific computing:*

Essential parts of an electronic computer, CPU, INPUT, OUTPUT, Devices, RAM, ROM, CD-ROM Familiarity with different operating systems in common use, Machine language, Assembly language (idea only), Characteristics & field of applications of high level languages such as BASIC, FORTRAN, C & $C^{++}$. Algorithm and flow chart for solving simple problems. Simple MS-DOS Commands, Development of simple programs in BASIC language using commands listed -- AUTO, CLOSE, CLS, DATA-READ, DAE, DEFFN, DELETE, DIM, END, FILES, FOR-NEXT, GOSUB-RETURN, GOTO, IF-THEN, IF-THEN-ELSE, INPUT, KILL, LET, LINE, LIST, LOAD, LPRINT, NEW, PRINT, REM, RUN, SAVE, SCREEN, STOP, SYSTEM.

## *Programming in Basic/Fortran:*

1. Write a program in Basic to find the largest side of a triangle where the three sides are given as input. First of all you have to check whether the three sides can form the triangle and then you have to find the largest side.

2. Write a program in Basic to find the area of a triangle using Hero's formula. The three sides are given as input. First of all you have to check whether the three sides can form a triangle and then you have to calculate the area of the triangle.

3. Write a program in Basic to check whether a right angle triangle is possible by the three sides given as input. First of all you have to check whether the three sides can form a triangle and then you have to check the condition for right angle triangle.

4. Write a program in BASIC to input an integer and print all its divisors at the output.

5. Write a program in BASIC to input 10 random numbers. Print all the odd numbers at the output.

6. Write a program in BASIC to input 10 random numbers. Print all the even numbers at the output.

7. Write a program in BASIC to find all the prime numbers from 1 to 100.

8. Write a program in BASIC to calculate the sum of 10 natural numbers.

9. Write a program in BASIC to calculate factorial of "N" where "N" is given as input.

10. Write a program in BASIC to input two numbers and calculate their L.C.M.

11. Write a program in BASIC to input two numbers and calculate their H.C.F.

12. Write a program in BASIC to input 10 numbers and print the numbers at the output in ascending order.

13. Write a program in BASIC to input 10 numbers and print the numbers at the output in descending order.

14. Write a program in BASIC to input 10 numbers and arrange the numbers in reverse order and print both the original order and reverse order in two columns at the output.

15. Write a program in BASIC to print 10 Fibonecci numbers at the output where T(1) = 0 and T(2)=1

16. Write a program in BASIC to input a temperature in Celsius scale and convert it into in Fahrenheit scale.

17. Write a program in BASIC to input a temperature in Fahrenheit scale and convert it into in Celsius scale.

18. Write a program in BASIC to input the radius of a sphere in centimetre and calculate its area and volume.

19. Write a program in BASIC to input a five digit number. Construct a new number where the digits are arranged in reverse order and print both five digit numbers at output.

20. Write a program in BASIC to input a five digit number. Construct a new number where the digits are arranged in ascending and descending order and print both five digit numbers at the output.

21. Write a program in BASIC to input the focal length of a convex lens. If the object distance is given, calculate the image distance.

22. Write a program in BASIC to input five resistances. Calculate the equivalent resistance when they are in parallel combintion.

23. Write a program in BASIC to print the first 10 terms of the following series.

0, 3, 8, 15, 24, 35.....

24. Write a program in BASIC to input the number of days and convert it into year, month and day.

25. Write a program in BASIC to find all the three digit numbers for which sum of the cube of the digits is equal to the number itself.

e.g. $153=1^3+5^3+3^3$ (Armstrong number)

# First Semester
# Core Course - Paper- II
## MECHANICS

TOTAL MARKS – 100
(Theory – 70, Practical-30)

### Unit-I Fundamental of mechanics & Oscillations (15 Lectures)

**Fundamentals of Dynamics:** Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

**Work and Energy:** Work and Kinetic Energy Theorem. Conservative and neoconservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.
**Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

### Unit-II General Properties of matter (15 Lectures)

**Elasticity:** Relation between Elastic constants. Cantilever, bending moment, twisting torque on a Cylinder or Wire.

**Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.
**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

### Unit-III Rotational Dynamics (15 Lectures)

**Rotational Dynamics**: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

**Unit-IV Relativity (15 Lectures)**

**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

**Reference Books:**


- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.


**Additional Books for Reference**


- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.


# Practical

1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) **g**
4. To determine the Moment of Inertia of a body about an axis passing through its centre of gravity.
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Young's Modulus of material of a rod by flexure method.
7. To determine the Modulus of Rigidity of a Wire by Statical method or dynamical method.
8. To determine the Young's modulus of a material of a wire by Searle's method.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum.

11. To determine the Moment of Inertia of a Flywheel.

**Reference Books**


- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.