MINUTES OF MEETING OF THE BOARD OF STUDIES IN PHYSICS HELD ON 17th FEBRUARY, 2024 at 10:00 am
Parvatibai Chowgule College of Arts & Science (Autonomous)
Margao – Goa

Vide Chowgule College notice F.133(C)/1312 dated 01 February, 2024) a meeting of this BOS was convened on 17th February, 2024 at 10:00 a.m. through online Google meet, Parvatibai Chowgule College of Arts & Science, Margao – Goa. Since the number of members present represented the Quorum, the BOS began its proceedings.

Members present:

1. Dr. Ashish M. Desai (Chairman)
2. Dr. Ananya Das (Member)
3. Mrs. Malati Dessai (Member)
4. Mr. Yatin P. Desai (Member Secretary)
5. Ms. Mrunal Shetkar (Member)
6. Ms. Pearl Oliviera (Member)
7. Dr. Bholanath Pahari (Academic Council Nominee)
8. Dr. Sudhir Cherukulappurath (Vice-Chancellor Nominee)

Member Absent

1. Dr. Tarun Kumar Jha (Academic Council Nominee)
2. Mr. Mangrish Salelkar (Industry Representative)
3. Mr. Harison Cota (Postgraduate Alumni)

Proceedings

The Chairperson welcomed the members of the Board of Studies (BOS). The Chairperson introduced and explained the agenda for the meeting and read out the minutes of the previous B.O.S. meet. The meet continued taking up the following agenda.

Agenda Items:

1. Approval of two Value Added Courses with Course Titles and Syllabus.
2. Approval of the syllabus of new multidisciplinary and skill enhancement courses for semesters I, II and III under NEP 2020.
3. Revision of CLO & alignment of CLO to PLO/ PO in accordance with OBE. Applicable only to the NEP implemented Syllabus.
4. Any Other Business (A.O.B.)

PART B: Important Points/ recommendations of BOS that require consideration / approval of Academic Council:

1. To seek approval the syllabi of the Skill enhancement courses for Semesters I, II, and III to be offered by the Department of Physics under NEP 2020 presented in Annexure I.
2. To seek approval the program learning outcomes of the Department of Physics presented in Annexure B.
3. To seek approval of adjustment of the course "Modern Physics" to be offered in Semester IV instead of Semester III for Physics students, as proposed and approved during the BoS meeting. The revised course structure is given in Annexure A.
4. To seek approval that the Minor in Physics Students from 2022-23 F. Y. B. Sc. batch can select any course in Semesters V and VI listed in Annexure A.

Mr. Yatin P. Desai
Member Secretary
Board of Studies

Dr. Ashish M. Desai
Chairperson
Board of Studies

Dated: 19th February 2024

Annexure A

(Summary of changes incorporated in the syllabus)

Semester	Existing (Indicate only the unit where the change is proposed)	Changes Proposed	Specify the reason for the change
I	Modern Physics offered in Semester III	Modern Physics offered in Semester IV	Due to the limited number of core courses available in Semester III, Modern Physics is shifted to Semester IV to accommodate students' academic objectives.
V (Only for the academic year 2024-25)	Courses currently offered in Semester V to the minor Physics students. 1. Thermodynamics and Statistical Mechanics or 2. Electromagnetic theory -II	Courses that will be offered in Semester V to the minor Physics students. 1. Solid State Physics or 2. Thermodynamics and Statistical Mechanics or 3. Mathematical Physics or 4. Solid State Devices	To accommodates their diverse interests and academic objectives.
VI (Only for the academic year 2024-25)	Courses offered in Semester VI to the minor Physics students. 1. Mechanics II or 2. Introduction to Materials Science	Courses that will be offered in Semester VI to the minor Physics students. 1. Atomic and Molecular Physics or 2. Mechanics II or 3. Nuclear and Elementary Particle Physics or 4. Introduction to Special Theory of Relativity. or 5. Mathematical Physics (if not offered in Semester V)	

Annexure B

Department of Physics

Program Learning Outcomes:

After successful completion of a three years Bachelor's degree in Physics, the student will be able to:

PLO-1: Strengthen understanding of Physics	Strengthen their understanding of core and applied areas of physics.
PLO-2: Solve complex problems.	Develop the ability to solve complex problems using mathematical and computational tools.
PLO-3: Hands-on experience in experimental physics	Acquire hands-on experience in experimental physics, demonstrating proficiency in laboratory techniques and analysis.
PLO-4: Scientific Communication Skills.	Effectively communicate scientific ideas, both in written and oral formats.

Annexure C

New Skill Enhancement Courses

(To be implemented w.e.f. Acad. Year 2024-2025)

Course Title : Python programming fundamentals and mathematical techniques.
Course Code : UG-PHY-SEC 4
Credits : 2 (Theory) + 1 (Practical)
Marks : 50 (Theory) + 25 (Practical)
Duration : 30 hrs. (Theory) + 30 hrs. (Practical)
Course Objectives : Introduce learners to the fundamentals of scientific Python programming with a focus on developing skills for problem-solving in scientific contexts.
Course Learning Outcomes: At the end of this course students will be able to:
CLO1: Demonstrate an understanding of basic Python elements, gain proficiency in implementing control structures and understand functions.
CLO2: Acquire skills in utilizing packages such as Numpy and Sympy.
CLO3: Understand various tests used to examine the convergence and divergence of different kinds of series and learn how to expand a function in power series.
CLO4: Learn basics of partial differentiation and its application.
Theory: **[15 h]**
Module I:

1. **Basic Elements of Python** **[5 h]**
   Variables. Mathematical & Logical operations. Python interpreter. Built-in functions. Input and Output. Commenting. Import modules.

2. **Loops, conditions, functions** **[5 h]**

   Loops: for loop. while loop.
   Conditions: Logical if. If-else, if-else-if
   Functions: Define ordinary functions. Function with arbitrary number of arguments. Function with keyword arguments. Local and global parameters in function. Function inside another functions.

3. **Numpy and Sympy:** **[5 h]**
   Numpy: Characteristics of arrays. Vectorized operations. Iterator on arrays. Axes of higher dimensional arrays. Various data types. Method of creation of arrays. Indexing of arrays. Slicing of arrays. Swap elements. Numpy methods on arrays. Check elements. Insert and delete elements. Append, Concatenate arrays. Split arrays. Stack arrays. Statistics over array, Product difference. Trace of array. Transpose flip rotate, Products of special kinds. Matrix like operations.
   Sympy: Symbols, Expressions, Calculations. Matrix. Calculus

Module II: **[15 h]**

1. **Infinite Series and Power Series** **[10 h]**

   Geometric Series and other infinite series. Convergent and Divergent Series. Testing series for convergence. Power series. Expanding functions in power series. Techniques for obtaining power series expansion.

2. **Partial Differentiation** **[5 h]**

   Definition of the partial derivative. Total differentials. Exact and inexact differentials. Theorems of partial differentiation. Chain rule. Thermodynamic relations. Differentiation of Integrals.

Practicals: (Minimum Six)

1. Programs on basic concepts of Python.
2. Programs that involve the management of program flow using conditional statements such as "if" and "elif".
3. Programs that require looping and iteration using control structures such as "for" and "while" loops.
4. Programs that employ built-in functions as well as functions that are created by the user.
5. Programs that utilize like Numpy Library.
6. Programs that utilize like Sympy Library.
7. Exploring series expansions using a programming language and its applications in physics.
8. Exploring vector algebra using Python.
9. Using programming to solve Partial Differentiation.

List of books recommended for reference

Mandatory Reading:

1. Gupta A. (2021). Scientific Computing in Python, 3rd Edition, Techno world, Kolkata.
2. Boas M. (2006). *Mathematical Methods in Physical Sciences* 3rd Edition, John Wiley and Sons, USA
3. Riley K. F., Hobson M. P., Bence S. J. (1998). *Mathematical Methods for Physics and Engineering*, Cambridge University Press, UK

Supplementary Reading:

1. Gupta B. D. (2004). *Mathematical Physics,* Vikas Publishing House, New Delhi
2. Hill C. (2020). *Learning Scientific Programming with Python*, 2nd Edition, Cambridge University Press.

Online resources:

1. https://www.w3schools.com/python/
2. https://www.tutorialspoint.com/python/index.htm
3. https://www.geeksforgeeks.org/python-programming-language/
4. https://ocw.mit.edu/resources/res-18-007-calculus-revisited-multivariable-calculus-fall-2011/
5. https://www.math.upenn.edu/~deturck/m104/notes/week6.pdf
6. http://tutorial.math.lamar.edu/Classes/CalcIII/CalcIII.aspx

Course Title : Matrices and Differential Equations

Course Code : UG-PHY-SEC 5

Credits : 2 (Theory) + 1 (Practical)

Marks : 50 (Theory) + 25 (Practical)

Duration : 30 hrs. (Theory) + 30 hrs. (Practical)

Course Objectives: To gain proficiency in matrix analysis and solve ordinary differential equation of first and higher order and apply these acquired skills across diverse fields and applications.

Course learning Outcomes: Upon completion of the course, the student will be able to

CLO1: Demonstrate proficiency in matrix analysis

CLO2: Obtain precise solutions for first-order differential equations

CLO3: Learn various techniques for obtaining solutions of second order differential equations

CLO4: Use computational techniques to solve several problems in matrices and differential equations.

Theory:

Module I: **[15 h]**

1. **Matrices** **[7 h]**

   Matrix Analysis and Notation, Matrix Operations, Properties of matrices. Transpose matrix. Complex Conjugate Matrix, Hermitian Matrix, Unit matrix, Diagonal matrix, Adjoint and self-adjoint matrix, symmetric matrix, anti-symmetric matrix, unitary matrix, orthogonal matrix, trace of a matrix, inverse matrix. Solution of a system of linear equations. The eigenvalue problem.

2. **Differential equation** **[8 h]**

   Introduction. Some simple situations where we come across ODE. First order ODE. Variable separable, Homogeneous, Non- Homogeneous, Exact differential equations, integrating factor, linear differential equations, Bernoulli equations.

Module II:

1. **Second order Differential equation** **[15 h]**

   Second-order differential equations, Homogeneous and non-homogeneous differential equations, complementary function, particular integral, General solution, complex solutions. Some methods of solving second-order differential equations (undetermined coefficients, variation of parameters, using one solution to find another). Finding particular integral by operator method. Linear differential equations of higher order.

Practicals: (Minimum Six)

1. Investigating Matrix Operations in Physics using a Programming Language -I
2. Investigating Matrix Operations in Physics using a Programming Language -II
3. Exploring Matrix Diagonalization: Eigenvalues and Eigenvectors in Python.
4. Exploring complex numbers using Python.
5. Applying programming techniques to solve ordinary differential equations.
6. Applying programming techniques to solve first order ordinary differential equations.
7. Applying programming techniques to solve second order differential equations

List of books recommended for reference

Mandatory Reading:

1. Harper C. (1978). *Introduction to Mathematical Physics*, Prentice Hall of India, New Delhi
2. Simmons G. F. (2017). *Differential Equations with Historical Notes*, Tata McGraw Hill

Supplementary Reading:

1. Gupta A, (2021). Scientific Computing in Python, 3rd Edition, Techno world, Kolkata.
2. Boas M. (2006). *Mathematical Methods in Physical Sciences* 3rd Edition, John Wiley and Sons, USA
3. Boyce W.E. & DiPrima R.C. (2017). *Elementary Differential Equations and Boundary Valued Problems*, John Wiley Pvt Ltd.
4. Braun C. (1992). *Differential Equations and Their Applications: An Introduction to Applied Mathematics* (Texts in Applied Mathematics), springer.
5. Coddington E. (2017). *Theory of Ordinary Differential Equations*, Tata McGraw Hill
6. Rainville E. D. (1996). *Elementary Differential Equations*, Pearson

Online resources:

1. https://ocw.mit.edu/resources/res-18-007-calculus-revisited-multivariable-calculus-fall-2011/
2. https://nptel.ac.in/courses/111108081/
3. https://www.youtube.com/playlist?list=PLkZjai-2Jcxlg-Z1roB0pUwFU-P58tvOx
4. https://www.youtube.com/playlist?list=PLDesaqWTN6ESPaHy2QUKVaXNZuQNxkYQ_
5. https://ocw.mit.edu/courses/res-18-009-learn-differential-equations-up-close-with-gilbert-strang-and-cleve-moler-fall-2015/

Course Title : Numerical Techniques

Course Code : UG-PHY-SEC 6

Credits : 2 (Theory) + 1 (Practical)

Marks : 50 (Theory) + 25 (Practical)

Duration : 30 hrs. (Theory) + 30 hrs. (Practical)

Course Objectives:
The aim of this course is to make the student acquainted with several computational techniques for solving a broad range of problems.

Course Learning Outcomes: At the end of this course students will be able to:
CLO1: Analyze errors arising in numerical computation of solutions to mathematical and applied problems. Solve algebraic equations numerically. Apply mathematical procedure for finding the best-fitting curve for a given set of points.
CLO2: Learn basic methods, tools and techniques of problem solving. Apply numerical techniques for differentiation and integration.
CLO3 Apply numerical techniques for solving ordinary differential equations
CLO4: Develop practical computational skills/techniques to solve various problems.

Theory:

Module I: **[15 h]**

1. **Errors in Numerical Calculations** **[6 h]**
   Preliminaries of Computing (Basic concepts)
   Errors and their computations, absolute, relative and percentage errors. A general error formula. Error in series approximation.

2. **Solution of Algebraic Equations** **[6 h]**
   Bisection method, iteration method, Newton-Raphson method, secant method.

3. **Least square curve fitting** **[3 h]**
   Fitting a straight line, Multiple linear least squares (function of two variables)

Module II: **[15 h]**

1. **Numerical differentiation and integration** **[8 h]**
   Forward differences. Numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.

2. **Numerical solution of ordinary differential equations** **[7 h]**
   Solution by Taylor series, Euler's Method, Runge-Kutta methods, Finite difference method

Practicals: (Minimum Six)

1. Introduction to a programming language.
2. Applying programming techniques/Excel to solve Linear equations using Bisection method.
3. Applying programming techniques/Excel to solve Linear equations Newton-Raphson method.
4. Applying programming techniques/Excel to solve differential Equation using Euler's Method.
5. Applying programming techniques/Excel to solve differential equation using Finite difference method.
6. Applying programming techniques/Excel to solve integrals using Trapezoidal rule.
7. Applying programming techniques/Excel to solve integrals using Simpson's 1/3 rule.
8. Applying programming techniques/Excel for Least Square Curve Fitting.

List of books recommended for reference

Mandatory Reading:

1. Sastry S. S. (2025). *Introductory Methods of Numerical Analysis*, PHI Learning Private Limited, Delhi

Supplementary Reading:

1. Verma P. K. and Ahluwalia and Sharma K. C. (1999). *Computational Physics*, New Age International Publishers, India.
2. Rajaraman V. (1999). *Computer Oriented Numerical Methods*, Prentice-Hall of India, New Delhi.

Online resources:

1. https://nptel.ac.in/courses/115/106/115106118/
2. https://www.youtube.com/watch?v=OQV8WmUdeIo
3. http://digimat.in/nptel/courses/video/111106101/L18.html
4. https://www.youtube.com/watch?v=r6MTvrI8SQ4
5. https://web.stanford.edu/class/me200c/tutorial_77/