

Lesson plans on Vector Analysis , Mathematical Physics-I in UG semester I Physics Hons Paper 101		
	By Shri Pankaj Sarkar	
Lecture Number	Plan of action	Students' participation
1	Recapitulation of vectors: Introduction to Vector, types, its importance	Revision and clearing doubts
2	Scalar Product, its geometrical significance, examples, applications	doing exercises
3	Properties of vectors under rotations. Scalar product and its invariance under rotations.	recapitulation and clearing doubts
4	Vector Product, its geometrical significance, examples, applications	to perform the relevant tasks
5	Scalar triple product, its geometrical significance, relevant exercises	
6	Concept of field, scalar field, vector field, their examples, introduction to the partial differentiation and vector operator	clearing doubts
7	Directional derivatives and normal derivative	
8	Gradient of a scalar field and its geometrical interpretation, exercises	clearing doubts
9	Divergence of a vector field and its geometrical interpretation, exercises	
10	Curl of a Vector field and its geometrical interpretation, exercises	
11	Del and Laplacian operators. Vector identities.	
12	Vector identities continued	
13-14	Class Test - 1	
15	Concept of integration, Vector integration	
16	Ordinary Integrals of Vectors, Multiple integrals, applications	to perform the relevant tasks
17	Jacobian, its applications	
18	line integration-examples	
19	Surface integration, examples	clearing doubts
20	Application of surface integration	to perform the relevant tasks
21	Volume integration, examples	
22	Applications of volume integration	to perform the relevant tasks
23-24	Class Teest-2	
25	Flux of a vector field,	
26	Gauss's Divergence theorem, applications	clearing doubts
27	Application of Gauss's theorem continues	to perform the relevant tasks
28	Green's theorem, its applications	clearing doubts
29	Application of Green's theorem continues	to perform the relevant tasks
30	Stokes Theorems and its applications	clearing doubts
31	Applications of Stokes theorem continues	to perform the relevant tasks
32-33	Class Test-3	
34	Introduction to Orthogonal Curvilinear Coordinates, scale factors, Covariant & Contravariant vector components	clearing doubts
35	determination of scale factors in Cartesian, Cylindrical and Spherical coordinate systems	
36	Derivation of Gradient, Divergence, del operator	
37	Derivation of curl, Laplacian	
38	Del operator, Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	to perform the relevant tasks
39-40	Class Test-4	

Course Name:	Classical Dynamics												
Course Code:	BPHSDSHT504												
Module Name:	Classical Dynamics												
Name of the teacher:	Dr. Saptarshi Chakraborty												
Alloted Lectures:	20	(Additional Tutorial Classes Required = 3)											
Objectives of the module:	Students will be able to answer the questions related to normal modes of oscillations and fluid motion and also able to solve the various numericals based on them.												
Class	Topics to be Covered										Mode of Teaching		
1	Minima of potential energy and points of stable equilibrium											Online	
2	Expansion of the potential energy around a minimum											Online	
3	Small amplitude oscillations about the minimum											Online	
4	Calculations of frequencies of normal modes of oscillations of N-oscillators system											Online	
T-1	One Tutorial Required to discuss the involved numerical part											Online	
E-1	CLASS TEST/PRESENTATION/QUIZ											Online	
5	Density and pressure in a fluid											Online	
6	An element of fluid and its velocity											Online	
7	Continuity equation and mass conservation											Online	
8	Stream lined motion											Online	
9	Laminar flow											Online	
10	Poiseuille's equation for a flow of a liquid through a pipe											Online	
T-2	One Tutorial Required to discuss the involved numerical part											Online	
11	Navier-Stokes equation											Online	
12	Qualitative description of turbulence											Online	
13	Reynolds number											Online	
T-3	One Tutorial Required to discuss the involved numerical part											Online	
E-2	CLASS TEST/PRESENTATION/QUIZ											Online	

Course Name:		ELECTRICITY & MAGNETISM						
Course Code:		BPHSCCHC201						
Module Name:		Electricity & Magnetism						
Name of the teacher: Moumita Patra								
Alloted Lectures:		60	(Additional Tutorial Classes Required = 10)					
Objectives of the module:		Give the students a clear & detailed idea about one of the most important Chapter of physics and to make them able to understand electric & magnetic properties of matter and also a clear idea about electric circuits						
Class	Topics to be Covered							
1	Introduction: Electric Field, Electric field lines							Online
2	Electric flux, Gauss' Law							Online
3	Gauss' Law with applications to charge distributions							Online
4	Charge distribution with spherical symmetry							Online
5	Charge distributions with cylindrical symmetry							Online
6	Charge distribution with planer symmetry							Online
T-1	One Tutorial Required to discuss the involved numerical part							Online
7	Conservative nature of electrostatic field							Online
8	Electrostatic Potential							Online
9	Laplace's and Poisson's equations							Online
10	The Uniqueness theorem							Online
11	Potential and electric field of a dipole							Online
12	Force and Torque on a dipole							Online
13	Electrostatic Energy of system of charges							Online
14	Electrostatic Energy of a charged sphere							Online
T-2	One Tutorial Required to discuss the involved numerical part							Online
15	Conductors in an Electrostatic field							

35	Ampere's Circuital Law and its application								Online
36	Calculation of B for an infinite straight wire & a infinite planar surface cur								Online
37	Solenoid and toroid								Online
38	Properties of B: curl & Divergence								Online
39	Axial vector property of B and its consequences								Online
40	Vector potential and Magnetic Force								Online
41	Torque on a current loop in a uniform magnetic field								Online
T-6	One Tutorial Required to discuss the involved numerical part								Online
42	Magnetization Vector & Magnetic Intensity								Online
43	Magnetic Susceptibility & Permeability								Online
44	Relations Between B,H,M								Online
45	Ferromagnetism ,B-H curve and Hysteresis								Online
T-7	One Doubt Clearing Class								Online
46	Faraday's Law & Lenz's Law								Online
47	Self Inductance								Online
48	Mutual inductance								Online
49	Reciprocity theorem, Energy stored in a Magnetic field								Online
50	Introduction to Maxwell's equations								Online
51	Charge conservation & Displacement Current								Online
E-2	Class test on previous topics								Online
52	Kirchoff's Laws for AC circuits								Online
53	Complex resistance and impedance								Online
54	Series LCR Circuit								Online
55	Parallel LCR Circuit								Online

T-8	One Tutorial Required to discuss the involved numerical part								Online
56	Ideal constant voltage & constant current sources								Online
57	Network theorem: Thevenin theorem & Norton theorem								Online
58	Superposition theorem & Reciprocity theorem								Online
59	Maximum Power transfer theorem								Online
60	Applications to DC circuits								Online
T-9	One Tutorial Required to discuss the involved numerical part								Online
T-10	Doubt Clearing Session(Whole Chapter)								Online
E-3	Terminal Exam								Online

Course Name:	Mathematical Physics-II																	
Course Code:	BPHSCCHC301																	
Module Name:	Mathematical Physics-II																	
Name of the teacher:		Dr. Saptarshi Chakraborty																
Alloted Lectures:		28		(Additional Tutorial Classes Required = 3)														
Objectives of the module:		Students will be able to solve the problems on the Power series solutions and on the special integrals.																
Class	Topics to be Covered								Mode of Teaching									
1	Singular Points of Second Order Linear Differential Equations and their importance										Online							
2	Frobinus method and its application to differential equation										Combin ed mode							
3	Legendre, Bessel, Hermite and Laguerre differential equations										Online							
4	Properties of Legendre Polynomials: Rodrigues Formula, Generating Functions, Orthogonality, Simple recurrence relations & Expansion of a function in series of Legendre Polynomials										Online							
5	Bessel functions of First kind, Generating function, Simple recurrence relation zeros of Bessel functions & Orthogonality										Online							
T-1	One doubt clearing class										Online							
E-1	CLASS TEST/PRESENTATION/QUIZ										Online							
6	Beta and Gamma Functions and relation between them										Online							
T-2	One Tutorial Required to discuss the involved numerical part										Online							
7	Error functions										Online							
T-3	One Tutorial Required to discuss the involved numerical part										Online							
E-2	CLASS TEST/PRESENTATION/QUIZ										Online							
8	Terminal Exmination										Online							

Course Name:		Mechanics									
Course Code:		BPHSCCHC102									
Module Name:		Oscillations									
Name of the teacher:		Dr. Saptarshi Chakraborty									
Alloted Lectures:		7	(Additional Tutorial Classes Required = 3)								
Objectives of the module:		Students will be able to answer the questions related to osillations. They will also be able to solve the numericals based on this.									
Class	Topics to be Covered						Mode of Teaching				
1	Simple Harmonic Oscillations (SHM)										Online
2	Differential equation of SHM and its solution										Online
3	Kinetic energy, Potential energy, Total energy and their time-average values										Online
T-1	One Tutorial Required to discuss the involved numerical part										Online
E-1	CLASS TEST/PRESENTATION/QUIZ										Offline
5	Damped oscillation										Online
T-2	One Tutorial Required to discuss the involved numerical part										Online
6	Forced oscillations: Transient and steady state										Online
7	Resonance & sharpness of resonance										Online
8	Power dissipation and quality factor										Online
T-3	One Tutorial Required to discuss the involved numerical part										Online
E-2	CLASS TEST/PRESENTATION/QUIZ										Online
9	Terminal Exmination										Online

Course Name:		Solid State Physics												
Course Code:		BPHSCCHC502												
Module Name:		Solid state physics												
Name of the teacher:		Dr. Saptarshi Chakraborty												
Alloted Lectures:		32	(Additional Tutorial Classes Required = 10)				6)							
Objectives of the module:		Give the students a clear & detailed idea about one of the most important Chapter of physics and to make them able to understand the structure of solids and its various properties, as well as its response to external electric and magnetic fields												
Class	Topics to be Covered													
1	Lattice vibrations and Phonons								Online					
2	Linear Monoatomic and Diatomic Chains								Online					
3	Acoustical and Optical Phonons								Online					
4	Qualitative Description of the Phonon Spectrum in Solids								Online					
5	Dulong and Petit's law								Online					
6	Einstein and Debye theories of specific heat of solids and T^3 law								Online					
T-1	One Tutorial Required to discuss the involved numerical part								Online					
7	Sommerfeld's free electron theory of metals								Online					
8	Free electron gas in three dimensions								Online					
9	Fermi energy, temperature, velocity and momentum								Online					
10	Concepts of energy bands in solids								Online					
11	Periodic potential and Bloch theorem (proof not required)								Online					
12	Qualitative discussion on Kronig-Penny model and energy band structure								Online					
13	Conductor, Semiconductor (P & N type) and Insulator								Online					
14	Conductivity of metal and semiconductor								Online					
T-2	One Tutorial Required to discuss the involved numerical part								Online					
15	Hall effect and experimental measurements of Hall cofficent								Online					

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Course Code:		BPHSCCHC501						
Module name:		Quantum Mechanics and Applications						
Name of the teacher:		Dr. Binoy Das						
Alloted Lectures:		22		(Additional tutorial classes required = 3)				
Objectives of the module:								
1. Angular momentum of electron in hydrogen like atom.								
2. Concept of space quantization.								
3. Space quantization and zeeman effect.								
4. Introduction of electron spin and calculation of spin angular momentum.								
5. Larmor's theorem and calculation of spin magnetic moment.								
6. Stern-Gerlach experiment.								
7. Electron magnetic moment and electron magnetic energy								
8. Concept of gyromagnetic ration and Bohr magneton.								
T1: One Tutorial Required to discuss the involved numerical part								
E1: Class test on previous topics								
9. Splittings of energy levels due to normal Zeeman effect.								
10. Splitting of energy levels due to anomalous Zeeman effect.								
11. Splitting of energy levels due to Paschen Back effect.								
12. Concept of Stark effect.								
E2: Class test on previous topics								
13. Pauli's exclusion principle.								
14. Symmetric and Antisymmetric wave function.								
15. Periodic table.								
16. Fine structure due to spin orbit coupling.								
17. Spectral notations for atomic states.								
18. Concept of total angular momentum.								

19. Vector atom model: L-S coupling									
20. Vector atom model: J-J coupling									
21. Hund's rule									
22. Spectra of Hydrogen and Alkali atoms.									
T3: One Tutorial Required to discuss the involved numerical part									
E3: Test Exam									

Course Name:	Mechanics						
Course Code:	BPHSCCHC102						
Module Name:	Mechanics						
Name of the teacher: . Dr. Binoy Das							
Alloted Lectures:	5		(Additional Tutorial Classes Required = 1)				
Objectives of the module:							
Class			Topics to be covered				
1. Concept of elasticity, stress strain curve.							Offline
2. Relation between elastic constants.							Offline
3. Twisting torque on a Cylinder or Wire							Offline
4. Concept of fluid motion.							Offline
5. Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.							Offline
T1. One Tutorial Required to discuss the involved numerical part.							Online
E1- Class Test on previous topics.							Online

Course Name:	Thermal Physics							
Course Code:	BPHSCCHC302							
Module Name:	Thermal Physics							
Name of the teacher:	Dr. BINOY DAS							
Alloted Lectures:		21	(Additional Tutorial Classes Required = 4)					
Objectives of the module:			Give the students a clear & detailed idea about one of the most important Chapter of physics and to make them able to understand kinetic theory of gases, molecular collisions and real gases.					
Class			Topics to be covered					
1. Derivation of Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas .								Online
2. Derivation of Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas , Evaluation of A and b terms.								Online
3. Experimental Verification of Maxwell-Boltzmann Law of Distribution of Velocities, Doppler broadening of spectra								Online
4. Experimental Verification of Maxwell-Boltzmann Law of Distribution of Velocities, Stern's experiments.								Online
5. Derivation of Mean, RMS and Most Probable Speeds.								Online
6. Concept of Degrees of Freedom. Law of Equipartition of Energy .								Online
7. Concept of Specific heats of Gases.								Online
T1. One Tutorial Required to discuss the involved numerical part.								Online
8. Concept and estimation of Mean Free Path.								Online
9. Deduction of coefficient of viscosity.								Online
10. Deduction of thermal conductivity and coefficient of diffusion.								Online
11. Concept of Brownian motion and its significance.								Online
T2. One Tutorial Required to discuss the involved numerical part.								Online
E1- Class Test on previous topic								Online
12.Behavior of Real Gases: Deviations from the Ideal Gas Equation.								Online
13. The Virial Equation.								Online
14. Andrew's Experiments on CO ₂ Gas.								Online
15. Concept of Continuity of Liquid and Gaseous State.								Online
16.Deduction of Van der Waal's Equation of State for Real Gases.								Online
17. Values of Critical Constants and Law of Corresponding States								Online
18. Joule's Experiment and Free Adiabatic Expansion of a Perfect Gas.								Online

19. Joule-Thomson Porous Plug Experiment.								Online
20. Joule- Thomson Effect for Real and Van der Waal Gases.								Online
21. Temperature of Inversion. Joule- Thomson Cooling.								Online
T3. One Tutorial Required to discuss the involved numerical part.								Online
T4. Doubt Clearing Session(Above topics)								Online
E3-Terminal Exam								Online

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19. Eigenvalues of one-dimensional potential box.										Offline
20.Eigen functions of step potential.										Offline
21. Eigenvalues of step potential.										Offline
22. Eigen functions of one dimensional rectangular potential barrier.										Offline
23. Eigenvalues of one dimensional rectangular potential barrier.										Offline
24. One dimensional rectangular potential well.										Offline
25. Derivation of energy eigenfunctions of harmonic oscillator.										Offline
26. Energy levels of harmonic oscillators.										Offline
27. Concept of ground state and zero point energy.										Offline
28. Uncertainty relation for the oscillator.										Offline
T3: One Tutorial Required to discuss the involved numerical part										Offline
29. Time independent Schrodinger equation in three dimensional spherical polar coordinate.										Offline
30. Wave functions of particle in a three dimensional box.										Offline
31. Concept of angular momentum operator and quantum numbers.										Offline
32. Continuation of angular momentum operator and quantum numbers.										Offline
33. Introduction of central field problem.										Offline
34. Derivation of wave functions of hydrogen-like atom using Frobenius method.										Offline
35. Continuation of the derivation of wave functions of hydrogen-like atom using Frobenius method.										Offline
36. Shape of the probability densities for ground and first excited states.										Offline
37. Concept of orbital angular momentum.										Offline
38. Concept of s, p, d shells.										Offline
T4: One Tutorial Required to discuss the involved numerical part										Offline
T5:Doubt clearing classes(Whole chapter)										Offline
E2: Class test on previous topics										Offline

Course Name:		Mechanics						
Course Code:		BPHSCCHC102						
Module Name:		Mechanics						
Name of the teacher: Moumita Patra.								
Alloted Lectures:	25	(Additional Tutorial Classes Required = 3)						
Objectives of the module:	Students will be able to answer the questions related to centre of mass and moment of inertia of different types of bodies. They will also be able to describe/ explain the various types of motion.							
Class	Topics to be Covered							
1	Review of Newton's laws of motion,Reference Frames							Online
2	Galilean transformation & Galilean invariance							Online
3	Momentum of variable mass system:Rocket motion							Online
								Online
4	Motion of projectile in uniform gravitational field							
5	Dynamics of a system of particles,Centre of mass						Combined mode	
T-1	One Tutorial Required to discuss the involved numerical part							Offline
6	Principle of conservation of momentum,Impulse							Offline
7	Work and Kinetic energy theorem.Conservative and non conservative forces							Offline
8	Potential energy,Qualitative study of 1-D motion from potential energy curve							Offline
9	Stable and unstable equilibrium,work & potential energy							Offline
10	Workdone by non-conservative forces.Law of conservation of energy							Offline
11	Elastic and inelastic collision between particles in laboratory frame							Offline
12	2-D elastic collision in centre of mass frame							Offline
13	Introduction to rotational dynamics							Offline
14	Angular momentum of a particle and syatem of particle						Combined Mode	
15	Torque or moment of force							Offline
T-2	One Tutorial Required to discuss the involved numerical part							Offline
E-1	CLASS TEST/PRESENTATION/QUIZ							Offline

16	Principle of Conservation of angular momentum							Offline
17	Rotation about a fixed axis							Offline
18	Moment of inertia,Parallel and perpendicular axis theorem							Offline
T-3	One Tutorial Required to discuss the involved numerical part							Offline
E-2	CLASS TEST/PRESENTATION/QUIZ							Offline
19	Calculation of moment of inertia for uniform bodies							Offline
20	calculation of moment of inertia for rectangular,cylindrical and spherical bodies							Offline
21	Motion in a vertical circle							Offline
22	Kinetic energy of rotation							Offline
23	Motion involving both translational and rotational							Offline
24	pure rolling on inclined plane							Offline
25	Terminal Exmination							Offline