FYUGP

PHYSICS HONOURS/ RESEARCH

FOR UNDER GRADUATE COURSES UNDER
BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

Implemented from
Academic Session 2022-2026

Sayantan Sil 15-09-22

15/09/22

15/9/2022

15/09/22

COURSE STUCTURE FOR FYUGP **'HONOURS/ RESEARCH'**

Table 1: Credit Framework for Four Year Undergraduate Programme (FYUGP) under State Universities of Jharkhand [Total Credits =176]

Semester	Common Courses (29)									Introductory Courses (15)		Internship/ Project (4)	Major (PHYSICS) (54) + Adv. Major (PHYSICS) (24)	Minor* (32)		Research Courses (18)				Total Credit
	Language and Communication Skills (Modern Indian Language including TRL) (6)	Language and Communication Skills (English) (6)	Environmental Studies (3)	Understanding India (2)	Health & Wellness, Yoga Education, Sports & Fitness (2)	Digital Education (3)	Mathematical & Computational Thinking and Analysis (2)	Value-Based Course/ Global Citizenship Education (2)	Community Engagement/ NCC/ NSS/ (3)	Introductory Courses [Natural Sc./ Humanities/ Social Sc./Commerce] (9)	Introductory Course [Vocational Studies] (6)			Natural Sc./ Humanities/ Social Sc./ Commerce (18)	Vocational Studies (14)	Research Methodology Courses (6)	Research Proposal, Review of literature (4)	Research Internship/ Field Work (4)	Preparation of the Research Project Report (4)	
1	2	3	4	5	6	7	8			9	10	11	14	15	16	17	18	19	20	21
I	6			2	2					3	3		6							**22**
II		6					2	2		3	3		6							**22**
Exit Point: Undergraduate Certificate																				
III			3			3			3	3		4	6							**22**
IV													6+6	6	4					**22**
Exit Point: Undergraduate Diploma																				
V													6+6	6	4					**22**
VI													6+6	6	4					**22**
Exit Point: Bachelor's Degree																				
VII													6+6 (Adv. Topics)			6	4			**22**
VIII													6+6 (Adv. Topics)		2			4	4	**22**
Exit Point: Bachelor's Degree with Hons. /Research																				

*A student has to select three subjects for 'Introductory Regular Courses' from a pool of subjects associated with the Major (PHYICS) offered by the institution. One of the three subjects will continue as 'Minor' from semester IV onwards, based on the academic interest and performance of the student.

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COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME

Table 2: Course structure for Undergraduate Certificate Programme *[May Exit after Sem.-II]*

Semester	Common Courses			Introductory Courses		Major	Total Credits
Sem.-I	LCS (MIL/TRL) (6 Credits)	Understanding India (2 Credits)	Health & Wellness, Yoga Education, Sports & Fitness (2 Credits)	IRC-1 (3 Credits)	IVS-1A (3 Credits)	MJ-1 (6 Credits)	(22)
Sem.-II	LCS (English) (6 Credits)	Global Citizenship Education (2 Credits)	Mathematical & Computational Thinking (2 Credits)	IRC-2 (3 Credits)	IVS-1B (3 Credits)	MJ-2 (6 Credits)	(22)

Total = 44 Credits

(LCS: Language and Communication Skills; MIL: Modern Indian Languages; TRL: Tribal Regional Languages; IRC: Introductory Regular Courses; IVS: Introductory Vocational Studies, MJ: Major)

Table 3: Course structure for Undergraduate Diploma Programme *[May Exit after Sem.-IV]*

Semester	Common Courses			Introductory	Major Courses Credits	Minor	Internship/ Project	Vocational	Total
Sem.-III	Environmental Studies (3 Credits)	Community Engagement/ NCC/ NSS (3 Credits)	Digital Education (3 Credits)	IRC-3 (3 Credits)	MJ-3 (6 Credits)		Internship/ Project (4 Credits)		(22)
Sem.-IV					MJ-4, MJ-5 (6+6=12 Credits)	MN-1 (6 Credits)		VS-1 (4 Credits)	(22)

Total = 88 Credits

(MN: Minor; VS: Vocational Studies)

Table 4: Course structure for Bachelor's Degree Programme *[May Exit after Sem.-VI]*

Semester	Major Courses	Minor Courses	Vocational	Total Credits
Sem.-V	MJ-6, MJ-7 (6+6 = 12 Credits)	MN-2 (6 Credits)	VS-2 (4 Credits)	(22)
Sem.-VI	MJ-8, MJ-9 (6+6= 12 Credits)	MN-3 (6 Credits)	VS-3 (4 Credits)	(22)

Total = 132 Credits

Table 5: Course structure for Bachelor's Degree with Hons./Research Programme

Semester	Advance Courses	Research Courses		Vocational	Total Credit
Sem.-VII	AMJ-1, AMJ-2 (6+6=12 Credits)	Research Methodology (6 Credits)	Research Proposal (4 Credits)		(22)
Sem.-VIII	AMJ-3, AMJ-4 (6+6=12 Credits)	Research Int./Field Work (4 Credits)	Research Report (4 Credits)	VSR (2 Credits)	(22)

Total = 176 Credits

(AMJ: Advance Major; VSR: Vocational Studies associated with Research)

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SEMESTER WISE COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME **2022 onwards**

Table 6: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		
	Code	Papers	Credits
I	CC-1	Language and Communication Skills (Modern Indian language including TRL)	6
	CC-2	Understanding India	2
	CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2
	IRC-1	Introductory Regular Course-1	3
	IVS-1A	Introductory Vocational Studies-1	3
	MJ-1	Major paper 1 (Disciplinary/Interdisciplinary Major)	6
II	CC-4	Language and Communication Skills (English)	6
	CC-5	Mathematical & Computation Thinking Analysis	2
	CC-6	Global Citizenship Education & Education for Sustainable Development	2
	IRC-2	Introductory Regular Course-2	3
	IVS-1B	Introductory Vocational Studies-2	3
	MJ-2	Major paper 2 (Disciplinary/Interdisciplinary Major)	6
III	CC-7	Environmental Studies	3
	CC-8	Digital Education (Elementary Computer Applications)	3
	CC-9	Community Engagement & Service (NSS/ NCC/ Adult Education)	3
	IRC-3	Introductory Regular Course-3	3
	IAP	Internship/Apprenticeship/ Project	4
	MJ-3	Major paper 3 (Disciplinary/Interdisciplinary Major)	6
IV	MJ-4	Major paper 4 (Disciplinary/Interdisciplinary Major)	6
	MJ-5	Major paper 5 (Disciplinary/Interdisciplinary Major)	6
	MN-1	Minor Paper 1 (Disciplinary/Interdisciplinary Minor)	6
	VS-1	Vocational Studies-1 (Minor)	4

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V	MJ-6	Major paper 6 (Disciplinary/Interdisciplinary Major)	6
	MJ-7	Major paper 7 (Disciplinary/Interdisciplinary Major)	6
	MN-2	Minor Paper 2 (Disciplinary/Interdisciplinary Minor)	6
	VS-2	Vocational Studies 2 (Minor)	4
VI	MJ-8	Major paper 8 (Disciplinary/Interdisciplinary Major)	6
	MJ-9	Major paper 9 (Disciplinary/Interdisciplinary Major)	6
	MN-3	Minor Paper 3 (Disciplinary/Interdisciplinary Minor)	6
	VS-3	Vocational Studies 3 (Minor)	4
VII	AMJ-1	Advance Major paper 1 (Disciplinary/Interdisciplinary Major)	6
	AMJ-2	Advance Major paper 2 (Disciplinary/Interdisciplinary Major)	6
	RC-1	Research Methodology	6
	RC-2	Research Proposal	4
VIII	AMJ-3	Advance Major paper 3 (Disciplinary/Interdisciplinary Major)	6
	AMJ-4	Advance Major paper 4 (Disciplinary/Interdisciplinary Major)	6
	RC-3	Research Internship/Field Work	4
	RC-4	Research Report	4
	VSR	Vocational Studies (Associated with Research)	2
		Total Credit	**176**

Abbreviations:

CC Common Courses
IRC Introductory Regular Courses
IVS Introductory Vocational Studies
IAP Internship/Apprenticeship/ Project
VS Vocational Studies
MJ Major Disciplinary/Interdisciplinary Courses
MN Minor Disciplinary/Interdisciplinary Courses
AMJ Advance Major Disciplinary/Interdisciplinary Courses
RC Research Courses
VSR Vocational Studies associated with Research

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Table 7: Semester wise Examination Structure for Physics Major:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure			
	Code	Papers	Credits (T+P)	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	MJ-1	Mathematical Physics-I	6 (4+2)	15	60	25
II	MJ-2	Mechanics & Waves	6 (4+2)	15	60	25
III	MJ-3	Electricity & Magnetism	6 (4+2)	15	60	25
IV	MJ-4	Optics & Electromagnetic Theory	6 (4+2)	15	60	25
	MJ-5	Mathematical Physics-II	6 (4+2)	15	60	25
V	MJ-6	Thermal & Statistical Physics	6 (4+2)	15	60	25
	MJ-7	Analog & Digital Electronics	6 (4+2)	15	60	25
VI	MJ-8	Quantum Mechanics	6 (4+2)	15	60	25
	MJ-9	Solid State Physics	6 (4+2)	15	60	25
VII	AMJ-1	To be selected from the pool of Advance papers	6			
	AMJ-2	To be selected from the pool of Advance papers	6			
	RC-1	Research Methodology	6			
	RC-2	Research Proposal	4			
VIII	AMJ-3	To be selected from the pool of Advance papers	6			
	AMJ-4	To be selected from the pool of Advance papers	6			
	RC-3	Research Internship/Field Work	4			
	RC-4	Research Report	4			
	VSR	Vocational Studies (Associated with Research)	2			
		Total Credit	**98**			

Note:

- Total 6 credits of AMJ papers will be distributed either as 4(T) +2(P) OR 6(T); depending upon the paper. Distribution of marks in Mid-Semester and End-Semester will be accordingly.

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LIST OF ADVANCE MAJOR (AMJ) PAPERS TO BE SELECTED BY THE STUDENTS FOR SEMESTER VII & VIII:

1. Experimental Techniques
2. Physics Of Devices And Instruments
3. Advanced Mathematical Physics-I
4. Classical Dynamics
5. Applied Dynamics
6. Communication Electronics
7. Nuclear And Particle Physics
8. Astronomy And Astrophysics
9. Atmospheric Physics
10. Nano Materials and Applications
11. Digital Signal Processing
12. Biological Physics
13. Embeded System: Introduction To Microcontrollers
14. Advanced Mathematical Physics-II
15. Physics of Earth
16. Medical Physics
17. Advanced Quantum Mechanics
18. Advanced Statistical Physics
19. Quantum and Nonlinear Optics
20. Laser and Plasma Physics
21. Particle Physics and Field Theory
22. Magnetohydrodynamics

Table 8: Semester wise Examination Structure for Physics Minor:

Semester	Code	Papers	Credits (T+P)	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
IV	MN-1	Mechanics & Waves	6 (4+2)	15	60	25
V	MN-2	Optics & Electromagnetic Theory	6 (4+2)	15	60	25
VI	MN-3	Thermal & Statistical Physics	6 (4+2)	15	60	25
		Total Credit	**18**			

MAJOR PAPERS
SEMESTER I

PHYSICS MJ 1: MATHEMATICAL PHYSICS-I

(Credits: Theory-04, Practicals-02)

MJ 1:Theory

Credit: 04 Lectures: 60

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05)	**Pass Marks: = 30**

Instruction to Question Setter for
Semester Internal Examination (SIE 10 marks):
*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*
End Semester Examination (ESE 60 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

Differential Equations: First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. **(8 Lectures)**

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. **(4 Lectures)**

Vector Calculus: 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. **(8 Lectures)**

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vectorfields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications. **(10 Lectures)**

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **(6 Lectures)**

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. **(4 Lectures)**

Fourier series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Fourier series of square, saw-tooth and triangular waves, Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **(14 Lectures)**

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). **(6 Lectures)**

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. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning
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.
11. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
12. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
13. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

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MJ 1:Practical

Credit: 04 Lectures: 60

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- The course will consist of lectures (both theory and practical) in the Lab
- Evaluation done not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

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 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:	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of pi (π)

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Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = I_0\left(\frac{\sin\alpha}{\alpha}\right)^2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. *sin θ, cos θ, tan θ, etc.*
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Attempt following problems using RK 4 order method: • Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dx} = -x$ for four initial conditions x(0) = 0, y(0) = -1, -2, -3, -4. Plot x vs y for each of the four initial conditions on the same screen for $0 \le t \le 15$ The differential equation describing the motion of a pendulum is $\frac{d^2\vartheta}{dt^2} = -sin(\vartheta)$. The pendulum is released from rest at an angular displacement α, i.e. $\vartheta(0) = \alpha$ and $\vartheta'(0) = 0$. Solve the equation for α = 0.1, 0.5 and 1.0 and plot ϑ as a function of time in the range $0 \le t \le 8\pi$. Also plot the analytic solution valid for small $\vartheta\left(sin(\vartheta)\right) = \vartheta$

Referred Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn. , 2007, Cambridge University Press.
- A first course in Numerical Methods, U.M. Ascher& C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n . , 2 0 0 7 , Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to computational Physics, T. Pang, 2nd Edn. , 2006,Cambridge Univ. Press
- Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

SEMESTER II

PHYSICS-MJ 2: MECHANICS & WAVES

(Credits: Theory-04, Practicals-02)

MJ 2:Theory

Credit: 04 Lectures: 60

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05)	Pass Marks: = 30

Instruction to Question Setter for
Semester Internal Examination (SIE 10 marks):
*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*
End Semester Examination (ESE 60 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. **(3 Lectures)**

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.**(3 Lectures)**

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. **(2 Lectures)**

Motion under Central Force: 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). **(6 Lectures)**

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. **(6 Lectures)**

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. **(4 Lectures)**

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Galilean transformation, 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. **(9 Lectures)**

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **(5 Lectures)**

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **(2 Lectures)**

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. **(4 Lectures)**

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. **(5 Lectures)**

Sound: Acoustics of buildings, Reverberation and time of reverberation - growth and decay of sound - Sabine's formula, Absorption coefficient & measurement. **(3 Lectures)**

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixedand Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N-Harmonic Waves. **(8 Lectures)**

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
5. Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
9. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
10. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
11. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Additional Books for Reference

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

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MJ 2:Practical

Credit: 04 Lectures: 60

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine **g** and velocity for a freely falling body using Digital Timing Technique
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.
13. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2–T law.
14. To investigate the motion of coupled oscillators.
15. To study Lissajous Figures.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S.Panigrahi&B.Mallick,2015, Cengage Learning India Pvt.Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
7. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19th Edition, 1995, Reprint 2014.

INTRODUCTORY REGULAR COURSE: PHYSICS

SEMESTER I/II/III

PHYSICS-IRC

(Credits: Theory-03 Lectures-45)

Marks: 100 (End Semester Examination=75, Semester Internal Examination=20, Class Performance & Attendance =05)	Pass Marks: = 40

Instruction to Question Setter for

Semester Internal Examination (SIE 20 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.*

Unit I General Physics (15 Lectures)

Units and Measurements Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Significant figures. Dimensions of physical quantities, dimensional analysis and its applications.

Scalar and vector quantities; position and displacement vectors, general vectors and their notations. Frame of reference, Motion in a straight line, uniform and non- uniform motion, and instantaneous velocity, uniformly accelerated motion. Motion in a plane, cases of uniform velocity and uniform acceleration, uniform circular motion.

Intuitive concept of force, Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion. Law of conservation of linear momentum and its applications.

Work, Energy and Power Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power.

Motion of System of Particles and Rigid Body.

Centre of mass of a two-particle system, momentum conservation and Centre of mass motion. Moment of inertia, radius of gyration.

Kepler's laws of planetary motion (statement only), universal law of gravitation. Acceleration due to gravity and its variation with altitude, depth and latitude (expression only)

Elasticity, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity (qualitative idea only), Poisson's ratio.

Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity. Surface energy and surface tension, application of surface tension ideas to drops, bubbles and capillary rise.

Unit II Heat and Thermodynamics **(04 Lectures)**

Heat, temperature, thermal expansion. Heat transfer-conduction, convection and radiation, thermal conductivity.

Thermal equilibrium and definition of temperature, Zeroth law of thermodynamics, heat, work and internal energy. First law of thermodynamics, Second law of thermodynamics: gaseous state of matter, change of condition of gaseous state -isothermal, adiabatic, reversible, irreversible, and cyclic processes.

Unit III Waves & Optics **(06 Lectures)**

Periodic motion - time period, frequency, displacement as a function of time, periodic functions and their application. Simple harmonic motion (S.H.M) and its equations of motion; phase; oscillations of a loaded spring- restoring force and force constant; energy in S.H.M. Kinetic and potential energies; simple pendulum derivation of expression for its time period.

Wave motion: Transverse and longitudinal waves, speed of travelling wave, displacement relation for a progressive wave, principle of superposition of waves.

Wave front and Huygen's principle, Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light.

Unit IV Electricity & Magnetism **(08 Lectures)**

Electric charges, Conservation of charge, Coulomb's law-force between two point charges. Electric field, electric field due to a point charge, electric field lines, Electric flux, statement of Gauss's theorem Electric potential, potential difference, electric potential due to a point charge. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics.

Electric current, flow of electric charges in a metallic conductor, Ohm's law, V-I characteristics (linear and non-linear), temperature dependence of resistance, Internal resistance of a cell, potential difference and emf of a cell, combination of resistors in series and in parallel, Kirchhoff's rules, Wheatstone bridge.

Concept of magnetic field, Biot - Savart law, Ampere's law, Gauss's law in Magnetism, Magnetic properties of materials- Para-, dia- and ferro - magnetic substances with examples, Magnetization of materials, effect of temperature on magnetic properties.

Unit V Electromagnetic Theory **(04 Lectures)**

Faraday's laws of Electromagnetic induction, induced EMF and current; Lenz's Law, Maxwell's electromagnetic field equations.

Basic idea of displacement current, Electromagnetic waves, their characteristics, their transverse nature (qualitative idea only). Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Unit VI Modern Physics **(08 Lectures)**

Photoelectric effect, Einstein's photoelectric equation-particle nature of light. Experimental study of photoelectric effect Matter waves-wave nature of particles, de-Broglie relation.

Rutherford's model of atom; Bohr model of hydrogen atom, Expression for radius of nth possible orbit, velocity and energy of electron in his orbit, of hydrogen line spectra (qualitative treatment only).

Sayantan Sil 15-09-22 15/09/22 15/09/22 15/9/22

Nuclei Composition and size of nucleus, nuclear force Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion.

Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Intrinsic and extrinsic semiconductors- p and n type, p-n junction Semiconductor diode - I-V characteristics in forward and reverse bias, application of junction diode -diode as a rectifier.

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
4. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
7. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.
8. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
9. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
10. Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
11. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
12. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
13. A Text Book of Optics, Dr. N. Subrahmanyam, Brijlal, Dr. M. N. Avadhanulu, S. Chand Publishers.
14. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
15. Basic Electronics, Arun Kumar, Bharati Bhawan, 1/e, 2007
16. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
17. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury 2017, McGraw-Hill.