Controller of Examinations
SAMBALPUR UNIVERSITY
JYOTI VIHAR, BURLA
Sambalpur (Odisha), PIN- 768 019

PHONE and Fax:0663-2430806
e-mail: coesuniv@gmail.com

Urgent **(Both by post and by e- mail)**

No. 7628 / Acd.-I **Dated:** 20-10-16

To

The Principals,
(All the Affiliated Colleges under Sambalpur University having
Three Year Degree Courses excluding Autonomous Colleges.)

Sub: Syllabus & Implementation of CBCS pattern **Arts/Science/Commerce (Pass and Hons.) from the Academic Session *2016-17.***

Ref :- This office letter No 5314/ Acd.-I dated 21.7.16 and letter No. 5970/Acd.-I dated 8.8.16.

Sir,

In continuation to the letters and the subject cited above, I am directed to intimate you that the Vice- Chancellor has been pleased to approve the syllabus for Courses / papers related to ***Physics*** for CBCS + 3 courses degree B.Sc.(Both Pass & Hons.) examinations under 6 (15) of O.U. Act -1989 giving it effect from the Academic Session, 2016-17. The detail Courses of Studies is enclosed herewith for your reference and necessary action.

This may kindly be noted that it is the final syllabus for *Physics* subject/ papers under CBCS pattern. It may be made available to teachers and students concerned. Further you are requested to ensure teaching of the courses in your colleges accordingly.

Any error and omission etc. may kindly be intimated to this office.

. Any queries on the matter may be made through e-mail: coesuniv@gmail.com.

Thanking you,

Yours faithfully,

Encl: ***As above***

18/10/16
Controller of Examinations

P.T.O.

Memo No. 7629 /Acd.-I(BOS), dtd. 20-10-16

Copy forwarded with enclosure for information and necessary action to:

1. The Chairman, Post Graduate Council, Sambalpur University.
2. The H.O.D. , P.G. Department of ***Physics*** , Sambalpur University.
3. The Director, College Development Council, Sambalpur University.
4. The Director, Directorate of Distance and Continuing Education, Sambalpur University.
5. The Co-ordinator, Private Examination Cell, Sambalpur University.
6. Asst. Registrar (Examination), Sambalpur University.
7. Programmer, University Computer Unit, Sambalpur University.
8. Asst. Controller of Examinations, Sambalpur University.
9. Section Officer / Assistant –in- Charge, ***e – Governance Cell,*** Sambalpur University with request to provide all the materials in the official web- site accordingly. (**as + 3 cbcs-syllabus – *Physics* –Final)**
10. Section Officers, Computer Unit, E.G.-I, EG-II, E.C-I, EC-II, EC-IV Sections.
11. Five spare Copies for Academic-I Sections with enclosure.

18/10/16

Controller of Examinations

Memo No. 7630 /Acd.-I(BOS), dtd. 20-10-16

Copy forwarded without enclosure for information and necessary action to:

1. ***The Dy. Director, e – Governance Cell,*** Sambalpur University with request for needful to provide all the materials in the official web- site accordingly .
2. P.A. to the Vice- Chancellor, Sambalpur University.
3. P.A. to the Registrar, Sambalpur University.
4. P.A. to the Controller of Examinations, Sambalpur University.

18/10/16

Controller of Examinations

Sn//-

PASS COURSES AT A GLANCE

SUBJECT: PHYSICS

DISCIPLINE SPECIFIC CORE-4 PAPERS

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
DSC-P-PHY-1	1st	**Mechanics**	4	2
DSC-P- PHY -2	2nd	**Electricity & Magnetism**	4	2
DSC-P-PHY -3	3rd	**Thermal Physics**	4	2
DSC-P-PHY -4	4th	**Elements of Modern Physics**	4	2

DISCIPLINE SPECIFIC ELECTIVE-2 PAPERS

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
DSE-P-PHY -1	5th	Quantum Mechanics and Applications	4	2
DSE-P-PHY -2	6th	**Electromagnetic Theory**	4	2

SKIL ENHANCEMENT COURSES-LIST-A *(Any 1 paper)*

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	
SEC- -1	3rd/4th/5th	Electrical circuits and Network Skills	2	
SEC- -2	3rd/4th/5th	Computational Physics Skills	2	

Overall Course structure for Honours & Pass;
Detail Courses for 1st Semester and 2nd Semester,
are enclosed for immediate implementation.
Details of III, IV, V, VI Semester Courses shall be following shortly.

15/9/16

DISCIPLINE SPECIFIC CORE-4 PAPERS(6 Cedit each, 4-Theory + 2 Lab)

1st Semester

DSC-P-PHY-1: MECHANICS

(Credits: Theory-04, Practicals-02)

Theory: 50 Lectures

Unit-I

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. **(6 Lectures)**

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- orces. 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. **(4 Lectures)**

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

Unit -II

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. **(11 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)**

Unit -III

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. **(3 Lectures)**

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.. **(5 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: **(5 Lectures)**

15/9/16

Unit-IV

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. **(3 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.

(10 Lectures)

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.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a short problem of 3/4 marks minimum.

DSC-P-PHY-1: Mechanics-LAB

60 Hours Lab(5 Hours/week and 12 weeks)

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.

15/9/16

11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

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.

15/9/16

Semester -2

DSC-P-PHY-2: ELECTRICITY AND MAGNETISM
(Credits: Theory-04, Practicals-02)

Theory: 50 Lectures

Unit-I

Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. **(4 Lectures)**

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

(5Lectures)

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application. **(8 Lectures)**

Unit-II

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. **(7 Lectures)**

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field**B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to Solenoid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. **(7 Lectures)**

Unit-III

Magnetic Properties of Matter: Magnetization vector **(M).** Magnetic Intensity**(H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. **(4Lectures)**

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations (Statement only). **(5Lectures)**

Unit -IV

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and Parallel LCR Circuit.

(4Lectures)

15/9/16

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits. **(4 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping.

(2 Lectures)

Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a short problem of 3/ 4 marks minimum.

DSC-P-PHY-2: ELECTRICITY AND MAGNETISM LAB

60 Hours Lab(5 Hours/week and 12 weeks)

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleigh's method.
15. To determine the mutual inductance of two coils by Absolute method.

15/9/16

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

HONOURS COURSES AT A GLANCE

SUBJECT: PHYSICS

DISCIPLINE SPECIFIC CORE (14 PAPERS) (Credit: 06 each)

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
DSC-H-PHY- 1	1st	Mathematical Physics-1	4	2
DSC-H- PHY -2		Mechanics	4	2
DSC-H- PHY- 3	2nd	Electricity & Magnetism	4	2
DSC-H- PHY- 4		Waves & Optics	4	2
DSC-H- PHY 5	3rd	Mathematical Physics-II	4	2
DSC-H- PHY -6		Thermal Physics	4	2
DSC-H- PHY -7		Digital Systems & Applications	4	2
DSC-H- PHY -8	4th	Mathematical Physics-III	4	2
DSC-H- PHY -9		Elements of Modern Physics	4	2
DSC-H- PHY -10		Analog Systems & Applications	4	2
DSC-H- PHY -11	5th	Quantum Mechanics & applications	4	2
DSC-H- PHY -12		Solid State Physics	4	2
DSC-H- PHY -13	6th	Electromagnetic Theory	4	2
DSC-H- PHY -14		Statistical Mechanics	4	2

DISCIPLINE SPECIFIC ELECTIVE (4 PAPERS) (Credit: 06 each)

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
DSE-H- PHY-1	5th	Classical Dynamics	5	1
DSE-H- PHY -2		Physics of Devices & Instruments	4	2
DSE-H- PHY -3	6th	Nuclear & Particle Physics	5	1
DSE-H- PHY -4		Astronomy & Astro-Physics	5	1

GENERIC ELECTIVE (4 PAPERS) (Credit: 06 each)

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
GE-H-PHY-1	1st	Mechanics (Same as DSC-H-PHY-2)	4	2
GE-H-PHY-2	2nd	Electricity & Magnetism (DSC-H-PHY-3)	4	2
GE-H-PHY-3	3rd	Thermal Physics	4	2
GE-H-PHY-4	4th	Elements of Modern Physics	4	2

SKIL ENHANCEMENT COURSES-LIST-A *(Any 1 paper)*

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	
SEC-H-PHY -1	3rd	Electrical circuits and Network Skills	2	
SEC-H-PHY -2	3rd	Computational Physics Skills	2	

DISCIPLINE SPECIFIC CORE (14 PAPERS)

Semester I

DSC-H-PHY- 1: MATHEMATICAL PHYSICS-I

(Credits: Theory-04, Practicals-02)

Theory:50 Lectures

The emphasis of course is on applications in solving problems of interest to physicists.

Unit-I

Calculus:

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).

(2 Lectures)

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. **(10 Lectures)**

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. **(5 Lectures)**

Unit -II

Vector Calculus:

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. **(4 Lectures)**

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field.**(6Lectures)**

Unit -III

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. **(12Lectures)**

Unit-IV

Orthogonal Curvilinear Coordinates:

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

Introduction to probability:

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. **(3 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. **(2 Lectures)**

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.

15/9/16

- 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

Scheme of Examination:

Duration: 2 Hours

Marks: 50

Six problems to be solved out Eight problems/proofs (2 from each Unit)

DSC-H-PHY-1: MATHEMATICAL PHYSICS-I LAB

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)
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 $\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dt} = -x$ 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 $0 \leq 1 \leq 15$ The differential equation describing the motion of a pendulum is $\frac{d_2\emptyset}{dt^2} = -\sin(B)$ The pendulum is released from rest at an angular displacement α, i. e. *B(0) = a and B′(0) = 0*. Solve the equation for α = 0.1, 0.5 and 1.0 and plot *B* as a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small *B (sin(B) = B*

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, 3rd Edn. , 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 rd Edn . , 2007 , 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.

15/9/16

DSC-H- PHY -2 : MECHANICS

(Credits: Theory-04, Practicals-02)

Theory: 50 Lectures

Unit-I

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. **(6 Lectures)**

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- orces. 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. **(4 Lectures)**

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

Unit -II

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. **(11 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)**

Unit -III

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. **(3 Lectures)**

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.. **(5 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. **(5 Lectures)**

Unit-IV

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. **(3 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. **(10 Lectures)**

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.

15/9/16

- 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.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a short problem of 3/4 marks minimum.

DSC-H- PHY -2 : Mechanics-LAB

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.

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.

15/9/16

Semester II

DSC-H- PHY- 3 : ELECTRICITY AND MAGNETISM
(Credits: Theory-04, Practicals-02)
Theory: 50 Lectures

Unit-I

Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. **(4 Lectures)**

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. **(5 Lectures)**

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application. **(8 Lectures)**

Unit-II

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. **(7 Lectures)**

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field**B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to Solenoid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. **(7 Lectures)**

Unit-III

Magnetic Properties of Matter: Magnetization vector **(M).** Magnetic Intensity**(H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. **(4 Lectures)**

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations (Statement only). **(5 Lectures)**

Unit -IV

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and Parallel LCR Circuit. **(4 Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits. **(4 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping.

(2 Lectures)

15/9/16

Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a short problem of 3/ 4 marks minimum.

DSC-H- PHY- 3: ELECTRICITY AND MAGNETISM LAB

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleigh's method.
15. To determine the mutual inductance of two coils by Absolute method.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

15/9/16

DSC-H- PHY- 4: WAVES AND OPTICS
(Credits: Theory-04, Practicals-02)
Theory: 50Lectures

Unit-I

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. **(4 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)**

Unit -II

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. **(5 Lectures)**

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and 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.**(6Lectures)**

Unit -III

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. **(3 Lectures)**

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **(8 Lectures)**

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. **(4 Lectures)**

Unit -IV

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) **(2 Lectures)**

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **(6 Lectures)**

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. **(6 Lectures)**

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

---

DSC-H- PHY- 4: WAVES AND OPTICS - LAB

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

15/9/16