Education to Excel

SBRR MAHAJANA FIRST GRADE COLLEGE (Autonomous)

Jayalakshmipuram, Mysuru – 570 012 Karnataka, INDIA

Affiliated to University of Mysore

Re-accredited by NAAC with 'A' Grade, College with Potential for Excellence

UG ☑ **PG** ☐

Syllabi of I and II Semester

B.Sc. – Physics

Choice Based Credit System - 2019

Credit Pattern for Courses

L: Lecture; T: Tutorial; P: Practicals

Sem	Type	Id	Course	L + T + P = Tot.
1	DSC	PHY101	Mechanics, Properties of Matter and Electrostatics	4 + 0 + 0 = 4
1	DSC	PHY102	Practical 1	0 + 0 + 2 = 2
2	DSC	PHY201	Heat, Thermodynamics and Sound	4 + 0 + 0 = 4
2	DSC	PHY202	Practical 2	0 + 0 + 2 = 2
3	DSC	PHY301	Electricity and Electromagnetism	4 + 0 + 0 = 4
3	DSC	PHY302	Practical 3	0 + 0 + 2 = 2
4	DSC	PHY401	Optics and Spectroscopy	4 + 0 + 0 = 4
4	DSC	PHY402	Practical 4	0 + 0 + 2 = 2
5	DSE	PHY501	Nuclear and Theoretical Physics	3 + 0 + 0 = 3
5	DSE	PHY502	Practical 5	0 + 0 + 1.5 = 1.5
5	DSE	PHY503	Practical 6	0 + 0 + 1.5 = 1.5
5	SEC	PHY511	Lasers and Fibre Optics	2 + 0 + 0 = 2
5	SEC	PHY512	Astronomy and Astrophysics	2 + 0 + 0 = 2
5	SEC	PHY513	Nano Materials	2 + 0 + 0 = 2
6	DSE	PHY601	Solid State Physics	3 + 0 + 0 = 3
6	DSE	PHY602	Practical 7	0 + 0 + 1.5 = 1.5
6	DSE	PHY603	Practical 8	0 + 0 + 1.5 = 1.5
6	SEC	PHY611	Optoelectronics	2 + 0 + 0 = 2
6	SEC	PHY612	Renewable Energy Sources	2 + 0 + 0 = 2
6	SEC	PHY613	Solving Problems in Physics	2 + 0 + 0 = 2

Credit means the unit by which the course work is measured. One hour session of Lecture or Tutorial per week for 16 weeks amounts to 1 credit. Two hours session of practical's per week for 16 weeks amounts to 1 credit per semester.

PHY101 (DSC) Mechanics, Properties of Matter and Electrostatics

Course duration: 16 weeks with 4 hours of instruction per week.

Part A: 32 hours

Frames of reference: Inertial reference frames with examples. Uniform rectilinear motion in an inertial frame – Galilean transformation equation. The Galilean principle of relativity. Motion in a non-inertial reference frame uniformly accelerated rectilinear motion-concept of fictitious force-illustration; plumb line accelerometer and a freely falling elevator. Qualitative discussion of centrifugal force, Coriolis force and earth as a non-inertial frame, Numerical problems. **[5 hours]**

Motion of a point particle: Point mass. The position vector $\vec{r}(t)$ of a moving point particle and its Cartesian components. Velocity and acceleration as the vector derivatives. Derivation of planar vector of a constant magnitude. Radial and transverse components of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion centripetal force, Numerical problems. **[4 hours]**

Rigid body dynamics: Review of definitions, Moment of inertia and radius of gyration. Review of statements of the theorems of the parallel and perpendicular axes. Expression for kinetic energy of a rigid body. Calculation of moment of inertia of thin uniform rod, rectangular lamina, circular lamina, and solid cylinder. Theory of compound pendulum, conditions for maximum and minimum period. Numerical problems. **[6 hours]**

Conservation of linear momentum: Conservation of the linear momentum for a system of two particles. Rocket motion in a uniform gravitational field (single stage rocket equation with and without gravity). Multistage rocket – elementary ideas. Elastic and inelastic collisions – Elastic head-on collision and elastic oblique collision in a lab frame, Reduced mass. Numerical problems. **[6 hours]**

Conservation of angular momentum: Review of angular momentum and Torque. Relation between angular momentum and torque. Law of conservation of angular momentum. Areal velocity derivation $\frac{dA}{dt} = \frac{1}{2}\ r^2\,\dot{\theta}\,\hat{n}$. Central force: Physical insight into the nature of central forces. Kepler's laws of planetary motion-derivation using Newton's law of gravitation. Numerical problems. **[5 hours]**

Conservation of energy: Conservative force and non conservative forces with examples. Conservation of energy in a conservative force field. Applications: (i) Vertical oscillations of a loaded light spring and (ii) Calculation of escape velocity in the gravitational field of the earth. Conditions for a geo-stationary satellite. Numerical problems. **[6 hours]**

Part B: 32 hours

Fluid Mechanics: Viscosity – Basic concepts, Variation of viscosity of liquids with temperature and pressure. Theory of rotational viscometer. **[3 hours]**

Surface Tension: Basic concepts. Pressure inside curved liquid surface, examples. Surface tension and interfacial tension by drop weight method. Surface tension and angle of contact of mercury by Quincke's method – Theory, Numerical problems. **[5 hours]**

Elasticity: Concepts of moduli of elasticity, Hooke's Law and Poisson's ratio σ. Relation between the elastic constants *(i) q, k, σ (ii) n, k, σ (iii) q, k, n* and limiting values for σ. Work done in stretching. Elastic potential energy. Bending moment. Theory of light single cantilever. I-section girders. Torsion – calculation of couple per unit twist. The Torsional pendulum, Static torsion, theory of Searle's double bar and experiment. Numerical problems. **[12 hours]**

Electrostatics: Mechanical force and electric pressure on a charged surface. The path traced by a charged particle in an electric field. The attracted disc electrometer – construction, theory and applications. Numerical problems. **[6 hours]**

Galvanometers: Moving coil galvanometer – construction, theory, damping correction, current sensitivity and charge sensitivity. Helmholtz galvanometer – Theory. Numerical problems. **[6hours]**

References

- Halliday D, Resnick R, and Walder J, Principles of Physics, 9th Edn., Wiley India Pvt. Ltd. (2013).
- Upadhyaya J C, Classical Mechanics, 2nd Edn., Himalaya publishing House (2017).
- Arora C L, and Hemne P S, Physics for Degree Students, Revised Edn., S Chand and Company (2012).
- Charles Kittel, and Walter Knight, Berkeley Physics Course, Mechanics Vol. 1, 2nd Edn., Tata McGraw Hill (2011).
- Arora C L, Refresher Course in B.Sc. Physics Vol. 1, Revised Edn., S Chand and Company (2008).
- Mathur D S, Elements of Properties of Matter, S Chand and Company (2007).
- Mathur D S, Mechanics, S Chand and Company (2007).
- Brij Lal, and Subrahmanyam N, Properties of Matter, 6th Edn., S Chand and Company (2002).
- Shankara Narayana S R, Mechanics and Properties of Matter, 2nd Revised Edn., Sultan Chand and Sons (1998).
- Tewari K K, Electricity and Magnetism, S Chand and Company (2007).
- Brij Lal, and Subrahmanyam N, A Text Book of Electricity and Magnetism, 19th Edn., Ratan Prakashan Mandir (2016).

PHY102 (DSC) Practical 1

Course duration: 16 weeks with 4 hours of lab work per week.

Any TEN of the following experiments:

1. Bar pendulum: Determination of the acceleration due to gravity and radius of gyration (graphical method).
2. Fly wheel: Determination of moment of inertia, mass and density.
3. Drop weight method: Determination of surface tension of liquid and interfacial tension between two liquids.
4. Quincke's method: Determination of surface tension and angle of contact of mercury.
5. Young's modulus : Single cantilever method using travelling microscope; Graphical Method.
6. Searle's double bar: Determination of *q, n and* σ
7. Torsional pendulum: Determination of the rigidity modulus
8. Determination of the Young's modulus by Dynamic method (using graph).
9. Spiral spring: Determination of the acceleration due to gravity (graphical method).
10. Verification of perpendicular axis theorem for a rectangular lamina.
11. Verification principle of conservation of energy.

PHY201 (DSC) Heat, Thermodynamics and Sound

Course duration: 16 weeks with 4 hours of instruction per week.

Part A: 32 hours

Kinetic theory: Maxwell's law of distribution of molecular velocity (no derivation); its interpretation. Degrees of freedom. Principle of equipartition of energy based on Kinetic theory of gases. Derivation of $U = 3/2RT$. Mean free path, Probability of a particle having mean free path. Real gases, Andrew's isothermal, Van der Waals equations – expression for critical constants, calculation of mean velocity, most probable velocity and RMS velocity. Numerical problems. **[8 hours]**

Thermal conductivity: Equation for the flow of heat through a solid bar. Ingen-hausz experiment, Determination of thermal conductivity of a bad conductor by Lee and Charlton method. Numerical problems. **[3 hours]**

Radiation: Planck's quantum theory of radiation. Induced and spontaneous emission of radiation. Distribution of energy in black body radiation- Lummer-Pringsheim experiment, Derivation of Planck's law of radiation using Einstein's A and B coefficients. Deduction of Rayleigh-Jeans law, Stefan's law and Wien's displacement law from Planck's law. Numerical problems. **[6 hours]**

Low temperature physics: Ideal gas and real gas. Van der Waals equation of state Porous plug experiment and its theory. Joule-Thomson expansion – expression for the temperature of inversion, inversion curve. Relation between Boyle temperature, temperature of inversion and critical temperature of a gas. Principle of regenerative cooling. Liquefaction of air by Linde's method. Adiabatic demagnetization. Numerical problems. **[8 hours]**

Thermodynamics: Review of basic concepts, Carnot's theorem, thermodynamic scale of temperature and its identity with perfect gas scale. Clausius – Clapeyron first Latent heat equation, effect of pressure on melting point of a solid, effect of pressure on boiling point of a liquid. Numerical problems. **[7 hours]**

Part B: 32 hours

Entropy: The concept of entropy. Change of entropy in reversible and irreversible cycles. Entropy and non available energy. Second law of thermodynamics in terms of Entropy. Entropy of ideal gas, Entropy of Steam and Mixtures. T – S diagram, concept of absolute zero and the third law of thermodynamics. Numerical problems. **[7 hours]**

Thermodynamic potentials and Maxwell's thermodynamic relations: Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs-

Helmholtz equations. Derivation of Maxwell's thermodynamic relations, Tds equations for C_p and C_v. Heat capacity equations. Numerical problems. **[8 hours]**

Sound: Waves in one dimension – Differential equation of wave motion, Expression for velocity of progressive waves in a medium, Laplace's Correction to Newton's formula. Expressions for frequency of vibration of a stretched string-harmonics, Longitudinal vibrations in a rod. Kundt's tube experiment, Numerical problems. **[7 hours]**

Analysis of complex waves: The Fourier series – evaluation of Fourier coefficients, Example of the square wave, saw tooth wave. **[4 hours]**

Superposition of simple harmonic motion – Lissajous' figures. Equation for damped vibrations. Forced vibration, solution in exponential form, Resonance, Expression for amplitude and phase at resonance. Numerical problems. **[6 hours]**

References

- Halliday D, Resnick R, and Walker J, Principles of Physics, 9th Edn., Wiley (2013).
- Dittaman R H, and Zemansky M W, Heat and Thermodynamics, 7th Edn., The McGraw-Hill (2007).
- Blundell S J, and Blundell K M, Concepts in Thermal Physics, 2nd Edn., Oxford University Press (2006).
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- Satya Prakash, Optics and Atomic Physics, 11th Edn., Ratan Prakashan Mandir (1994).
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- Subramanyam N, Brij Lal, Waves and Oscillations, 2nd Edn., Vikas Publishing House Pvt. Ltd. (2005).
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- Gupta S K, Verma O P, Waves and Oscillations, 3rd Edn., R Chand and Co. (1998).
- Saihgal R L, A Text Book of Sound, S Chand and Company (1990).

PHY202 (DSC) Practical 2

Course duration: 16 weeks with 4 hours of lab work per week.

Any TEN of the following experiments:

1. Verification of Gaussian distribution law and calculation of standard deviation – Monte Carlo experiment.
2. Specific heat of a liquid by cooling – graphical method.
3. Determination of thermal conductivity of a bad conductor by Lee-Charlton method.
4. Stefan – Boltzmann law: Verification.
5. Determination of boiling point of a liquid using platinum resistance thermometer.
6. Determination of moment of inertia of irregular body using torsional pendulum.
7. Determination of Young's modulus by Koenig's method.
8. Determination of rigidity modulus by the static torsion method.
9. Determination of Young's modulus by uniform bending using travelling microscope (using graph).
10. Study of stationary wave on a stretched string – Determination of speed of the transverse waves over the sonometer wire.
11. Helmholtz resonator – Determination of frequency of a tuning fork.

Description of the paper

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Scheme of Valuation for Practicals

C1 and C2 are internal tests to be conducted during 8th and 16th weeks respectively of the semester. C3 is the semester-end examination conducted for 3 hours. The student will be evaluated on the basis of skill, comprehension and recording the results.

The students has to compulsorily submit the practical record during C1 and C2. For C3, the record has to be certified by the Head of the Department.

- The student is evaluated for 10 marks in C1 and C2 as per the following scheme:
  Experiment: 10.

  The marks scored is then normalised for 5.

- The student is evaluated for 40 marks in C3 as per the following scheme:

Heading	Marks
Experiment	25
Viva	05
Record	10
Total	40

The experiment portion of evaluation is carried out as per the following scheme:

Heading	Marks
Formula with proper units and explanation	05
Setting up the apparatus/circuit connection	05
Taking reading and tabulating	05
Calculation	05
Graph and accuracy of result	05
Total	25

SEC Courses: 511-513, 611-613, and similar courses

Max Marks: 40 Time: 2 hours

Part A

Long answer questions; Answer 2 out of 3 2 X 8 = 16

Part B

Long answer questions; Answer 2 out of 3 2 X 8 = 16

Part C

Short answer questions; 3 questions from each part; Answer 4

4 X 2 = 8