Detailed B.Sc. Physics Syllabus

Course No.	Course Title	Course Code	Credits	Hour	Periods (50 min)	Module	Lectures per module (50 minutes)	Examination		
								Internal Marks	External Marks	Total Marks
SEMESTER III										
Core courses THEORY										
I	Mechanics 2	22US3PHCC1MEC2	2	30	36	3	12	40	60	100
II	Electronics 2	22US3PHCC2ELE2	2	30	36	3	12	40	60	100
III	Thermodynamics	22US3PHCC3THD	2	30	36	3	12	40	60	100
Core courses PRACTICAL										
I, II &III		22US3PHCCP	3					60	90	150
SEMESTER IV										
Core courses THEORY										
I	Optics	22US4PHCC1OPT	2	30	36	3	12	40	60	100
II	Electricity and magnetism	22US4PHCC2EAM	2	30	36	3	12	40	60	100
III	Quantum Mechanics	22US4PHCC3QME								
Core courses PRACTICAL										
I, II &III		22US4PHCCP	3					60	90	150

S.Y. B. Sc. (Physics) SEMESTER III

Core Course- I

COURSE TITLE: Mechanics 2

COURSE CODE: 22US3PHCCIMEC2 [CREDITS - 02]

Course learning outcomes
After the successful completion of the Course, the learner will be able to: 1. Identify sources of error in measurement and analyse the possible errors in various experimental systems. 2. Use different mathematical methods to derive solutions of homogeneous equations. 3. Use Newton's equation of motion and energy methods to model vibrating mechanical systems. (damped, forced vibrations and compound pendulum) 4. Review various parameters affecting vibration of systems and their applications in real world. 5. Calculate and represent the stress diagrams in bars and simple structures 6. Test problems relating to pure and non-uniform bending of beams and other simple structures and torsional deformation of bars and other simple tri-dimensional

Module 1	Theory of errors	[12L]

Learning objectives:

The module is intended to

1. Describe the difference between accuracy and precision, and identify sources of error in measurement
2. Estimate the errors in the measurement and calculations.
3. Infer matrices and their application in homogenous equations.
4. Explain various orders of differential equations and then use on physical systems.

Learning outcomes:

After the successful completion of the module, the learner will be able to:

1. Categorize various types of errors & different methods to measure them. 2. Discuss about the basic theory of errors, their analysis, and estimation with examples of simple experiments in Physics. 3. Determine the solutions of homogeneous equations using matrices. 4. Derive the solution for various differential equations.		
1.1	Elementary theory of error Measurement and uncertainties, Accuracy and precision, Absolute and relative errors, various kinds of errors. Methods to minimize different types of errors. JCP: 1.1, 1.3, 2.1, 2.2, 2.3, 3.4, 3.5, 3.6, 3.6(a), 3.6(b), 3.10, 3.10(a), 3.11.	[4L]
1.2	Statistical Theory of errors The normal distribution, The average or mean value of measurements, average errors, the average or mean value of measurements, average errors, standard errors, probable errors. Propagation of errors. H.D: 4.18, 4.19, 4.34, 4.38, 4.41, 4.42, 4.43	[4L]
1.3	Matrices Introduction of various types of matrices (Review), Inverse of Matrix using Gauss Jordan method, Rank of matrix by triangular form, types of linear equations, consistency of a system of linear equations, solving simultaneous and homogeneous equations using matrices. H.D: 3.5, 3.7-3.11, 3.18, 3.19, 3.20, 3.21	[4L]
1.4	Differential equations Ordinary differential equations, first order homogeneous and nonhomogeneous equations with variable coefficients, Equations reducible to homogeneous form, Second-order homogeneous and non-homogeneous equations with constant coefficients, Method for finding complementary function and particular integrals	
Module 2	**Damped and Forced Vibrations**	**[12L]**
Learning objectives: The module is intended to		

1. Explain various types of damping, setup and solve the differential equations of a damped harmonic oscillator. 2. Study forced vibrations and resonance. 3. Infer the need of compound pendulum over simple pendulum and its real-life applications.		
Learning outcomes: After the successful completion of the module, the learner will be able to: 1. Classify damping and derive the equation of motion of damped oscillations. 2. Explain the concept of resonance and its impact on the amplitude of an oscillator. 3. Infer the characteristics of a system oscillating in resonance, 4. Comprehend the theory of compound pendulum.		
2.1	Damped Vibrations: Decay of free vibrations of a simple harmonic oscillator due to the damping force proportional to the first power of velocity, types of damping, Energy of a damped oscillator, logarithmic decrement, relaxation time and quality factor. HP: 9.3, 9.4.	[4L]
2.2	Forced vibration and resonance: Forced damped harmonic oscillator, special cases: low driving frequency, high driving frequency, Resonance. Quality factor of a driven oscillator. HP: 9.6, 9.7.	[4L]
2.3	Compound pendulum: Expression for period, maximum and minimum time periods, Centres of suspension and oscillations, Kater's reversible pendulum, Advantages of a compound pendulum over a simple pendulum. HP: (pages 279 to 289)	[4L]
Module 3	**Bending of Beams**	**[12L]**
Learning objectives: The module is intended to 1. Differentiate between laboratory and center of mass system		

2. Obtain the relationship between various physical parameters in laboratory and center of mass frame.
3. Infer the concept of bending of beams.

Learning outcomes:

After the successful completion of the module, the learner will be able to:

1. Establish relation for different physical parameters between lab and center of mass reference frames.
2. Derive an expression for bending moment of a beam.
3. Determine elastic constants by Searle's method

3.1	Collisions: Introduction, types of collisions, laboratory and centre of mass systems, relationship between displacements and velocities, relationship between angles. H.P.: 7.1, 7.3, 7.3.1, 7.3.2.	[5L]
3.2	Bending of beams: bending moment, Basic assumptions for theory of bending, cantilever, beam supported at its ends and loaded in the middle, I-section girders, determination of Y by bending, Determination of elastic constants by Searle's method. BS: 10.16, 10.17, 10.18, 10.19, 10.20, 10.22, 10.23, 10.26	[7L]

References:

- CH: Introduction to Mathematical Physics: Charlie Harper 2009 (EEE) PHI Learning Pvt. Ltd
- H. P. : Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd Ed.)
- B. S. : Mechanics and Electrodynamics. – Brij Lal, N. Subramanyam, Jivan Seshan, S. Chand (Revised and Enlarged Edition 2005)
- R.H: Mathematical methods for Physics & Engineering (3rd Edition)- K.F.Riley, M.V.Hobson & S.J.Bence Cambridge University Press.
- HD: Mathematical Physics- H.K Dass- S Chand and Company LTD
- P N Roy: A text book of Bio Physics- P N Roy, New Central Book Agency Ltd. Revised Edition, Reprinted in 2009.
- CRK: Research Methodology- C R Kothari, New Age International- second revised edition 2004.

- S P Puri. Fundamental of Vibrations and Waves. (Tata Mc Graw Hill)
- K R Symon Mechanics: [Addition & Wesley (3rd Ed)]
- D. S. Mathur Mechanics – (S Chand & Co.)
- Bhargava and Sharma Text book of Mechanics:
- J Topping Error of observation and their treatment – (Institute of Physics Monographs for students Series.)
- John R Taylor An introduction to error Analysis: University Science Books: Mill Valley California

Question Paper Template
S.Y. B. Sc. (Physics) SEMESTER III
Core Course- I
COURSE TITLE: Mechanics
COURSE CODE: 22US3PHCCIMEC2 [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	07	10	08	05	-	-	30
II	08	10	07	05	-	-	30
III	12	10	06	02	-	-	30
Total marks per objective	27	30	21	12			90
% Weightage	30%	33.33%	23.33%	13.33%	-	-	100

S.Y. B. Sc. (Physics) SEMESTER III

Core Course- II

COURSE TITLE: Electronics2

COURSE CODE: 22US3PHCC2ELE2 [CREDITS - 02]

Course learning outcome
After the successful completion of the Course, the learner will be able to: 1. Infer the basics of transistor biasing, CE amplifiers, their applications. 2. Explain the ideal characteristics of Op-Amp, the basic concepts of oscillators and perform calculations using them to design different Op-Amp and oscillator circuits. 3. Infer and illustrate the working of digital circuits.

Module 1	Amplifiers	[12L]

Learning objectives:

The module is intended to

1. Recall various BJT parameters, connections and configurations
2. Infer the need of transistor biasing and various biasing techniques.
3. Explain and Demonstrate BJT Amplifier,
4. Demonstrate and Construct Frequency response of BJT amplifiers at various frequencies.

Learning outcomes:

After the successful completion of the module, the learner will be able to:

1. Acquire knowledge of and Working principles, characteristics and basic applications of BJT and amplifiers,
2. Design transistorized amplifier and oscillator circuits.
3. Obtain stability factor using various biasing techniques
4. Interpret performance characteristics of transistor amplifiers, frequency Response and Oscillators.

1.1	Transistor fundamentals: The load line, operating point, recognizing saturation, transistor switch, Base Bias method, Emitter biased method, Voltage divider bias method, load line and Q-point. M: 7.2, 7.3, 7.4, 7.5, 8.1, 8.3	[6L]
1.2	Transistor amplifiers: Base-biased amplifiers, Emitter-biased amplifier, small-signal operation, Current gain , AC resistance of the emitter diode, two (p & T)) transistor model, categorizing an amplifier, voltage gain, frequency response of an ac amplifier, decibel voltage gain. M: 9.1, 9.2, 9.3, 9.3, 9.4, 9.5, 9.6, 9.7, 10.1, 16.1, 6.3, 16.4	[6L]
Module 2	**Amplifiers**	**[12L]**

Learning objectives:

The module is intended to

1. Infer and use the concept of feedback in electronic circuits.
2. Study different oscillator circuits.
3. List the ideal characteristics of operational amplifier.
4. Have a broad coverage in the field that is relevant for engineers to design Linear circuits using Op-amps

Learning outcomes:

After the successful completion of the module, the learner will be able to:

1. Use the concept of feedback and design various electrical circuits using transistor and Op-Amp.
2. Design OP Amp as Summer, Subtractor, integrator and differentiator.

2.1	**Feedback amplifiers:** (a) Negative feedback- principles, Gain, advantages	[6L]

	(b) Positive feedback-oscillator, essentials of transistor oscillator and Barkhausen criterion for self-sustained oscillations, Colpitt's oscillator, Wien bridge oscillator.	
2.2	**Operational Amplifiers:** Ideal characteristics, Schematic symbol, bandwidth, slew rate, applications: inverting amplifier, non-inverting amplifier, voltage follower, summing amplifier, integrator, differentiator, comparator with Zero reference and non-Zero reference (only). M&M: 13.1, 13.2, 13.3, 13.4, 13.5, 14.5, 14.6, 14.7, 14.10, 14.17, 14.18, 14.19, 14.20, 22.1,22.2,25.15, 25.16, 25.17,25.18, 25.19, 25.20, 25.24, 25.26, 25.27, 25.32, 25.35, 25.37	[6L]
Module 3	**Combinational Logic circuits**	**[12L]**

Learning objectives:

The module is intended to

1. Study the theory of Boolean algebra and to study representation of switching functions using Boolean expressions and their minimization techniques.
2. Study the combinational logic design of various logic and switching devices and their realization.
3. Study the sequential logic circuits design both in synchronous and Asynchronous modes for various complex logic and switching devices, their minimization techniques, and their realizations.

Learning outcomes:

After the successful completion of the module, the learner will be able to:

1. Use the concepts of Boolean Algebra for the analysis & design of various combinational & sequential logic circuits.

2. Infer the importance of K-Map over Boolean Algebra.		
3.1	Review: Boolean laws and Theorems, implementation of the logic circuits) Implementation of logic circuit from truth tables: Sum of products and product of sums method	[1L] [2L]
3.2	Combinational logic circuits: Karnaugh Map: truth table to Karnaugh Map, Pair, QUADs, OCTETs, don't care condition.	[3L]
3.3	Flip flops. Flip-flop and counters: R-S flip flops, clocked RS flip flop D Flip flop, edge triggered J K flip flop, Master slave flip flop, T flip flop, 4-bit binary ripple counter, Decade counter M&L: 3.3,3.4,3.5,3.6, 8.1, 8.2, 8.5, 8.7, 10.1	[6L]

References:

- M: A P Malvino and David J Bates Electronics principles: 7th Ed. The McGraw-Hill companies.
- M&M: V K Mehta, Rohit Mehta. Principles of Electronics:
- M&L: Malvino and Leach Digital Principles and Applications: fifth Ed
- D. Chattopadhyay & P. C. Rakshit Electronics Fundamental and applications (8th Ed.) (New Age International)
- Robert Boylestand & Louis Nashelsky Electronic Devices and Circuit theory, (PHI)
- Allen Mottershead Electronic devices and circuits – An introduction (PHI Pvt. Ltd. – EEE – Reprint – 2007)

Question Paper Template

S.Y. B. Sc. (Physics) SEMESTER III

Core Course- II

COURSE TITLE: Electronics2

COURSE CODE: 22US3PHCC2ELE2 [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	05	10	10	05	-	-	30
II	05	10	05	05	05	-	30
III	05	10	05	05	05	-	30
Total marks per objective	15	30	20	15	10		90
% Weightage	16.67%	33.33%	22.22%	16.67%	11.11	-	100

S.Y. B. Sc. (Physics) SEMESTER III

Core Course- III

COURSE TITLE: Thermodynamics

COURSE CODE: 22US3PHCC3THD [CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to: 1. Infer and solve problems involving the concept heat, Path function, process, heat engine, Carnot`s cycle and efficiency. 2. Infer and solve problems involving laws of thermodynamics, phase change, Triple point, latent heat, petrol engine and diesel engine. 3. Infer the concept of entropy in the context of second and third law of thermodynamics.		
Module 1	First Law of thermodynamics	[12L]
Learning objectives: The module is intended to: 1. Present a comprehensive and rigorous treatment of classical thermodynamics. 2. Lay the groundwork for subsequent studies in such fields as fluid mechanics, heat transfer and to prepare the students to effectively use thermodynamics in physics 3. Develop an intuitive Inferring of thermodynamics by emphasizing the physics and physical arguments.		
Learning outcomes: After the successful completion of the module, the learner will be able to: 1. Explain the basic concepts of thermodynamics like system, properties, path functions, zeroth law of thermodynamics, first law of thermodynamics and temperature measurement. 2. Infer Carnot Cycle to use for further applications.		

1.1	Concept of heat, the first law, non-adiabatic processes and Heat is a path function, Internal energy, Ref. EG: Chapter 3, Page No. 44 to 64.	[4L]
1.2	Reversible and irreversible process, Heat engines, definition, of efficiency, Carnot's ideal heat engine, Carnot's cycle, effective way to increase efficiency, Carnot's engines and refrigerator, coefficient of performance and related problems. Ref. BS: 4.20 To 4.29, 6.11	[8L]
Module 2	**Second Law of thermodynamics**	**[12L]**
Learning objectives: The module is intended to 1. Use second law to general reversible processes and cycles 2. Infer working of different heat engines. 3. Calculate theoretical efficiencies of heat engines. 4. Infer latent heat and its applications.		
Learning outcomes: After the successful completion of the module, the learner will be able to: 1. State and prove the equivalence of two statements of second law of thermodynamics. 2. Define reversible process and state the propositions regarding efficiency of Carnot cycle. 3. Evaluate the feasibility of a thermodynamic cycle using the second law of thermodynamics for Inferring, using, categorizing heat engines.		
2.1	Second law of thermodynamics, Carnot's theorem, Phase Change, Triple point of water, Latent heat, Clapeyron's latent heat equation using Carnot's cycle and its applications.	[6L]

2.2	Otto engine, petrol engine, diesel engine, Related problems BS: 1) 4.20 TO 4.29, 6.11 BS: 2) 4.30 TO 4.33	[6L]
Module 3	**Third Law of thermodynamics**	**[12L]**
Learning objectives: The module is intended to 1. Infer the concept of entropy as a state function. 2. Infer the role of entropy in reversible and irreversible processes. 3. Introduce the concept of negative temperature.		
Learning outcomes: After the successful completion of the module, the learner will be able to: 1. Evaluate entropy changes for reversible and irreversible processes. 2. Use entropy as a state variable 3. Give different statements of the third law 4. Prove the unattainability of absolute zero 5. Infer the importance of low temperature physics,		
3.1	Concept of entropy, change in entropy in adiabatic process, change in entropy in reversible cycle, Principle of increase of entropy, Change in entropy in irreversible process.	[2L]
3.2	T-S diagram, Physical significance of Entropy, Entropy of a perfect gas, Kelvin's thermodynamic scale of temperature, (Omit alternative method using Carnot cycle), the size of a degree, Zero of absolute scale, Identity of a perfect gas scale and absolute scale.	[2L]
3.3	Third law of thermodynamics, Zero-point energy, Negative temperatures (not possible), Heat death of the universe. BS: 5.1 TO 5.9, 5.11 TO 5.18 [Note: A sizeable number of numerical examples are expected to be covered during the prescribed lectures.]	[3L]

3.4	Low temperature Physics: Different methods of liquification of gases (Not in detail, just introduction), Method of freezing, Cooling by Adiabatic Expansion	[5L]

References:

- BS: Brij Lal, Subrahmanyam, Hemne (S. Chand (Revised Multicoloured Ed. 2007)Heat, Thermodynamics and statistical Physics-
- KK: S. K. Kakani and Amit Kakani, Material Science –New Age International (P) Ltd. – Reprint 2004.
- BV: B. Viswanathan, Nano materials, Narosa Publication House, Fourth Reprint- 2013.
- Ajay Kumar Saxena Solid State Physics: Macmillian India Ltd. (2006 Ed)
- R. S. Khurmi & R. S. Sedha Material Science: (S. Chand & Co. Ltd.) 5th Rev. & Enlarged Ed-2007.
- P Khanna- Dhanpat Rai Material Science and Metallurgy – Publication (XI Reprint)
- Hans. C. Chanian Modern Physics: – Prentice – Hall of India.
- D S Murty, V. Laxminarayana, Bangar Raju. Atomic Physics: Tata Mc. Graw Hill Publication Co. Ltd.
- B S Murthy, P Sarkar, Baldev Raj, R B Rathi, James Murday Textbook of Nano science and Nano technology: University Press. First Ed.

Question Paper Template

S.Y. B. Sc. (Physics) SEMESTER III

Core Course- III

COURSE TITLE: Thermodynamics

COURSE CODE: 22US3PHCC3THD [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	07	10	08	05	-	-	30
II	08	10	07	05	-	-	30
III	12	10	06	02	-	-	30
Total marks per objective	27	30	21	12			90
% Weightage	30%	33.33%	23.33%	13.33%	-	-	100

S.Y. B. Sc. (Physics)

SEMESTER III - Practical

COURSE CODE: 22US3PHCCP Credit- 02

Learning objectives:

The Practical is intended to

1. Infer and practice the skills while doing physics practical.
2. Handling of instruments.
3. Correlate theory concepts through practical.
4. Be able to estimate errors in experimental result

Learning outcomes:

After the successful completion of the practical, the learner will be able to:

1. Demonstrate their practical skills more effectively.
2. Infer and practice the skills while doing physics practical.
3. Infer the use of apparatus and their use without fear.
4. Correlate their physics theory concepts through practical.
5. Infer the concepts of errors and their estimation

Core Course I

1. Bar Pendulum. determination of g
2. Resonance Pendulum.
3. Searle's Experiment: determination of Y.
4. Logarithmic Decrement. (By lamp and scale)
5. Y by bending.
6. Optical Lever (Determination of R.I.)
7. Flat Spiral Spring (Y)

Core Course II
1. CE Amplifier: Frequency response. 2. CE Amplifier: Gain Vs Load. 3. Colpitt's Oscillator 4. Wein bridge oscillator (transistorized). 5. Op amp: Inverting amplifier. / Non-Inverting amplifier with different gains 6. Op amp: Difference amplifier 7. Implementing logic gates using K Map 8. Op amp: Integrator
Core Course III
1. Temperature Coefficient of thermistor 2. Surface Tension by Jagger's method 3. Determination of thermal conductivity of bad conductor by Lee's Method. 4. Verification of Stefan's Law 5. Refractive Index of liquid using LASER
Skill Experiments
1. Wiring of a simple circuit using bread board Connections. 2. Focal length by auto collimation method. 3. Phase shift measurement using dual trace CRO. 4. Designing & Soldering of simple Circuits. (e.g., Filter circuits) 5. Radius of ball bearing using single pan balance. 6. Spectrometer--Schuster's method 7. Estimation of experimental error.
Minimum of 4 experiments from each Courses should be completed. All the skill experiments are to be reported in journal. Certified journal is must to be eligible to appear for the semester end practical examination.

S.Y. B. Sc. (Physics) SEMESTER IV

Core Course- I

COURSE TITLE: Optics

COURSE CODE: 22US4PHCC1OPT [CREDITS - 02]

Course learning outcomes
After the successful completion of the Course, the learner will be able to: 1. Infer and use phenomenon thin film interference. 2. Elaborate polarization, various methods of production of polarized light and its application. 3. Distinguish between interference and diffraction pattern and infer the different types of diffraction. 4. Explain and differentiate Fraunhofer's and Fresnel diffraction patterns. 5. Describe interferometers and its applications. 6. Explain and evaluate the resolving power of different optical instruments.

Module 1	Interference	[12L]

Learning objectives:

The module is intended to

1. Study the phenomenon and application of thin film Interference.
2. Elaborate polarization and various methods of production of polarized light.
3. Use the knowledge to solve the problems related to interference and polarization.

Learning outcomes:

After the successful completion of the module, the learner will be able to

1. Describe the phenomenon and application of thin film Interference.
2. Explain various types of polarization, double refraction and theory of $\lambda/2$ and $\lambda/4$ plates and its application.

1.1	Interference: Light waves, superposition of waves, interference, theory of interference, techniques of obtaining interference, (i) Interference in thin films (ii) Newton's rings. Applications of thin film interference; Newton's ring (measurement of wavelength and refractive index) Ref: SBA: 14.2, 14.3, 14.4, 14.41, 14.8, 15.2, 152.1, 15.2.2, 15.2.3, 15.2.4, 15.6, 15.6.1, 15.6.2, 15.6.3, 15.6.4, 15.6.7	[6L]
1.2	Polarization: Introduction, type of polarization, polarization by reflection, Brewster's law, polarization by double refraction, the phenomenon of double refraction, Theory of λ/2 and λ/4 plates. Ref: SBA: 20.1, 20.2, 20.3, 20.4, 20.5, 20.6.1, 20.6.1.1, 20.6.5, 20.11, 20.11.3	[6L]
Module 2	**Diffraction**	**[12L]**

Learning objectives:

The module is intended to

1. Explain theory of Fresnel and Fraunhoffer diffraction.
2. Study diffraction patterns using single slit and multiple slits.
3. Use the theories of diffraction to solve numerical.

Learning outcomes:

After the successful completion of the module, the learner will be able to

1. Distinguish between interference and diffraction pattern.
2. Differentiate between Fresnel and Fraunhoffer types of diffraction.
3. Explain single slit and multiple slits diffraction patterns.
4. Solve numerical related to Fresnel and Fraunhoffer diffraction.

2.1	Fresnel's diffraction: Introduction, Huygen's-Fresnel's theory, Fresnel's assumptions, rectilinear propagation of light, distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction, diffraction due to straight edge, position of maximum and minimum intensity, intensity at a point inside a geometrical shadow, Ref" SBA: 17.1, 17.2, 17.3, 17.4 17.6, 17.7, 17.10, 17.10.1, 17.10.2	[6L]
2.2	Fraunhoffer diffraction: Introduction, Fraunhoffer diffraction at a single slit, intensity distribution in diffraction pattern due to single slit, Fraunhoffer diffraction at N slit, Plane diffraction grating, theory of plane transmission grating, width of principal maxima, prism and grating spectra. Ref: SBA: 18.1, 18.2, 18.2.1, 18.2.2, 18.4, 18.4., 18.6, 18.7, 18.7.1, 18.7.2, 18.7.8 (I to VI)	[6L]
Module 3	**Interferometer**	**[12L]**

Learning objectives:

The module is intended to

1. Study construction and working of Michelson interferometer and Fabry-Perot interferometer.
2. Infer various applications of interferometer.
3. Study Rayleigh criteria and resolving power of telescope, prism and grating.

Learning outcomes:

After the successful completion of the module, the learner will be able to

1. Explain construction and working of Michelson interferometer and Fabry-Perot interferometer.
2. Explain applications of interferometers.
3. State Rayleigh criteria and determine resolving power of telescope, prism and grating.

3.1	Michelson Interferometer: Principle, construction, working, circular fringes, localised fringes, Visibility of fringes. Applications of Michelson interferometer: Measurement of wavelength Determination of the difference in wavelengths of two waves Thickness of thin transparent sheet. Measurement of Gravitational waves.	[4L]
3.2	Fabry-Perot interferometer and etalon: Formation of fringes, determination of wavelength, Measurement of difference in wavelength. Ref: SBA: 15.7, 15.7.1 to 15.7., 15.8, 15.8.1 o 15.8.3, 15.12, 15.12.1 to 15.12.3	[4L]
3.3	Resolving Power: introduction, Rayleigh's criterion, resolving power of optical instruments, criterion for resolution according to Lord Rayleigh's, resolving power of telescope, resolving power of a prism, resolving power of a plane transmission grating. Ref: SBA: 19.1, 19.2, 19.5, 19.6, 19.7, 19.11, 19.12.	[4L]

References:

- SBA: Subramanyam, Brij Lal, Avadhanulu A text book of Optics –– S. Chand & Co. Multicoloured Ed. 2007.
- Optics – Ajay Ghatak (3rd Ed) Mc. Graw Hill Co.

Question Paper Template
S.Y. B. Sc. (Physics) SEMESTER IV
Core Course- I
COURSE TITLE: OPTICS
COURSE CODE: 22US4PHCC1OPT [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	04	10	10	06	-	-	30
II	10	10	08	02	-	-	30
III	06	12	08	04	-	-	30
Total marks per objective	20	32	26	12			90
% Weightage	22%	35%	29%	13%	-	-	100

S.Y. B. Sc. (Physics) SEMESTER IV

Core Course- II

COURSE TITLE: Electricity and Magnetism

COURSE CODE: 22US4PHCC2EAM [CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to: 1. Infer the vector analysis. 2. Acquire the knowledge of the vector calculus for solving physics problems. 3. Infer the basic laws of electrostatics and magneto statics and use them to perform calculations. 4. Infer concept of electric field (E) and electric potential for discrete and continuous charge distribution. 5. State Amper's law and use them to physics problems. 6. Evaluate the motion of charged particle in electric & magnetic field.		
Module 1	**Vector calculus**	**[12L]**
Learning objectives: The module is intended to 1. Infer and use vector calculus. 2. To learn vector calculus with derivatives, gradient, divergence and curl		
Learning outcomes: After the successful completion of the module, the learner will be able to 1. Perform various operations like vector addition, cross products, dot (scalar) products and their physical meanings. 2. Have a good intuition of the physical meaning of the various vector calculus operators and the important related theorems (Gauss–divergence theorem and stokes theorem of vectors).		
1.1	Triple products, the operator, the gradient, divergence and the curl, product rules. The fundamental theorem of	[12L]

	gradient divergence and curl, spherical polar coordinates, one dimensional and three-dimensional Dirac- delta function. Integration of vectors: line integral, surface integral, volume integral of vector field. Gauss-divergence theorem and Stokes theorem of vectors (statement only). Ref: DG: 1.1.3, 1.2.2 TO 1.2.6, 1.3.3, 1.3.4, 1.3.5, 1.4.1, 1.4.2, 1.5.2, 1.5.3. HD: 5.40,5.41,5.42	
Module 2	**Electrostatics & Magnetostatics**	**[12L]**
Learning objectives: This module is intended to 1. Introduce the basic mathematical concepts related to electromagnetic vector fields. 2. Impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications. 3. Impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.		
Learning outcomes: After the successful completion of the module, the learner will be able to 1. Infer the basic mathematical concepts related to electromagnetic vector fields. 2. Use the principles of electrostatics to the solutions of problems relating to electric field and electric potential and electric energy density. 3. Use the principles of magnetostatics to the solutions of problems (using Ampere's Law) relating to magnetic field and magnetic potential.		
2.1	The Electrical Field: Introduction, Coulomb's Law, The Electrical Field, Continuous charge distribution, electric potential, introduction to potential, comments on potential, the potential of a localized charge distribution.	[4L]

2.2	Work And Energy in Electrostatics: The work done in moving a charge, the energy of a point charge distribution, the energy of continuous charge distribution.	[4L]
2.3	Magnetostatics: The Biot-Savart law, applications of Biot-Savart law, Magnetic field due to a current carrying straight wire, circular loop, Helmholtz coils and solenoid. Ampere's law Ref: DG: 2.4.1 TO 2.4.4	[4L]
Module 3	**Charged particle dynamics**	**[12L]**
Learning objective: The module is intended to compare the effects of the electric and the magnetic fields on the charged particle		
Learning outcomes: After the successful completion of the module, the learner will be able to 1. Infer motion of charged particle in uniform and alternating electric field. 2. Infer motion of charged particle in uniform magnetic field. 3. Infer motion of charged particle in combine electric and magnetic field.		
3. 1	Kinetic energy of a charged particle in an electric field, motion of a charged particle in a constant electric field, Charged particle in an alternating electric field, Thomsons parabolas and positive ray analysis. Force on a charged in a magnetic field. Charged particle in a uniform and constant magnetic field, The Cyclotron. Velocity selector	[7L]
3.2	Motion of a charged particle in combined electric and magnetic field: Case I: Parallel electric and magnetic field Case II: Crossed electric and magnetic field, Bainbridge mass spectrometer. Ref: HP: 13.1, 13.2, 13.3, 13.4, 13.5,13.5.1,13.6, 13.6.1	[5L]

References:

- HP: – HS. Hans and S. P. Puri Mechanics Tata Mc. GrawHill (2nd Ed.)
- DG: David J. Griffiths Introduction to Electrodynamics –Prentice Hall India (EEE) 3rd Ed.
- CR: D. Chattopadhyay and P. C. Rakshit Electricity and Magnetism - Books and allied (P) Ltd. Reprint 2000 (4th Edition.)
- R.H: K.F.Riley, M.V.Hobson & S.J.Bence Mathematical methods for Physics & Engineering (3rd Edition)- Cambridge University Press.
- HD: H.K Dass- S Chand Mathematical Physics- Company LTD

Question Paper Template
S.Y. B. Sc. (Physics) SEMESTER IV
Core Course- II
COURSE TITLE: Electricity and Magnetism
COURSE CODE: 22US4PHCC2EAM [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	05	10	05	05	05	-	30
II	10	10	05	05		-	30
III	05	10	05	05	05	-	30
Total marks per objective	20	30	15	15	10		90
% Weightage	22.22%	33.33%	16.67%	16.67%	11.11	-	100

S.Y. B. Sc. (Physics) SEMESTER IV

Core Course- III

COURSE TITLE: Quantum Physics

COURSE CODE 22US4PHCC3QME [CREDITS - 02]

Course learning outcome
After the successful completion of the Course, the learner will be able to: 1. Discuss the postulates of quantum mechanics and its importance in explaining significant phenomena in Physics. 2. Use of mathematical operators, setting up Schrodinger time dependent and time independent equation and its interpretations. 3. Solve Schrodinger equation for wave functions of various simple quantum mechanical potentials (one-dimensional, step, three-dimensional potential) and different application problems. 4. Examine the barrier tunnelling phenomena for a barrier of finite height and width. 5. Solve Schrödinger equation to obtain the energy and wave functions of the quantum harmonic oscillator.

Module 1	The Schrodinger wave equation:	[12L]
Learning objectives: The module is intended to 1. Infer the postulates of quantum mechanics and its importance in explaining significant phenomena in Physics. 2. Demonstrate quantitative problem-solving skills in different topics covered.		
Learning outcomes: After the successful completion of the module, the learner will be able to 1. Use eigen value formalism to find operator expectation values.		

	2. Formulate the Schrodinger time independent and dependent equation 3. Derive equation of continuity with physical significance.	
1.1	Background Reading (Review): Matter waves-De Broglie hypothesis, Wave particle duality, Concept of wave packet, phase velocity, group velocity, Heisenberg's uncertainty principle, The Schrodinger wave equation: Concept of wave function, Born interpretation of wave function., Concepts of operator in quantum mechanics examples – position, momentum and energy operators. , Eigenvalue equations, expectation values of operators. ,	[6L]
1.2	Schrodinger equation, Postulates of Quantum Mechanics. Time dependent and time independent (Steady State) Schrodinger equation, Stationary State. Superposition principle. Equation of continuity and its physical significance.	[6L]
Module 2	**Applications of Schrodinger steady state equation - I**	**[12L]**
Learning objectives: This module is intended to 1. Infer the behaviour of quantum particle encountering a i) barrier ii) potential 2. Solve non-relativistic hydrogen atom problem and obtain its spectrum and eigen functions.		
Learning outcome: After the successful completion of the module, the learner will be able to 1. Solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three-dimensional potentials.		

2.1	Free particle., Particle in infinitely deep potential well (one - dimension). Step potential. Particle in three-dimension rigid box, degeneracy of energy state.	[12L]

References:

- Morrison R.T. and Boyd, R.N. Organic chemistry, Dorling Kindersley (India)pvt. Ltd. (Pearson Education), 2012.
- Mc Murry J.E,.Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- B.Y.Paula Organic Chemistry 8th edition, 2020, Pearson.

Module 3	Applications of Schrodinger steady state equation –II	[12L]

Learning objectives:

The module is intended to

1. Infer a given problem such as potential barrier and harmonic oscillator.
2. Infer real world applications of barrier tunnelling and the quantum harmonic oscillator.

Learning outcomes:

After the successful completion of the module, the learner will be able to

1. Develop and model a given problem such as potential barrier and harmonic oscillator.
2. Elaborate the salient features of finite width barrier and quantum harmonic oscillator potential.

3.1	Potential barrier (Finite height and width), penetration and tunnelling effect (derivation of approximate transmission probability), Theory of alpha particle decay from radioactive nucleus. Harmonic oscillator (one-dimension), correspondence principle.	[12L]

References:

- A. Beiser (6th Ed.) Concepts of Modern Physics –Tata McGraw Hill.
- S P Singh, M K Bagade, Kamal Singh, - S. Chand: 2004 Ed. Quantum Mechanics
- R. Eisberg and R. Resnik Nuclei and particles. - Published by Wiley.
- D. Griffiths Introduction to Quantum Mechanics. - Published by Prentice Hall.
- Ghatak and Lokanathan Quantum Mechanics. - Published by Mc. Millan.
- L. I. Schiff Quantum Mechanics. -. (4th edition Tata McGraw Hill)
- Powell and Crasemann, Quantum Mechanics. - Wesley Pub. Co.

Question Paper Template

S.Y. B. Sc. (Physics) SEMESTER IV

Core Course- III

COURSE TITLE: **Quantum Physics**

COURSE CODE: **22US4PHCC3QME** [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	07	10	08	05	-	-	30
II	08	10	07	05	-	-	30
III	12	10	06	02	-	-	30
Total marks per objective	27	30	21	12			90
% Weightage	30%	33.33%	23.33%	13.33%	-	-	100

S. Y. B. Sc. (Physics)

SEMESTER IV - Practical

COURSE CODE: 22US4PHCCP Credit- 03

Learning objectives:

The practical is intended to

1. Infer and practice the skills while doing physics practical.
2. Handling of instruments.
3. Correlate theory concepts through practical.
4. Infer the concepts of errors and their importance.

Learning outcomes:

After the successful completion of the practical, the learner will be able:

1. Acquire practical skills of handling different instruments.
2. Demonstrate different optical phenomenon.
3. Analyse data, plot graph and interpret.
4. Estimate the experimental errors.

Core Course I

1. Determination of Cauchy's constant.
2. Cylindrical obstacle: determination of wavelength.
3. Resolving power of telescope.
4. Brewster's Law.
5. Newton's Rings (Determine wavelength of Na source)
6. Single slit Diffraction using spectrometer.
7. Lycopodium powder.

8. Determination of wavelength of sodium source using diffraction grating.

Core Course II

1. LCR transients.
2. Passive Low pass filter. /High pass filter
3. Figure of merit of a mirror galvanometer
4. Superposition Theorem.
5. LCR Parallel resonance.
6. Determination of absolute Capacity by BG.
7. Maxwell bridge.
8. G by Shunting.

Core Course III

1. Designing Debounce circuit
2. Study of RS and JK Flip Flop.
3. Four bits synchronous counter.
4. Op amp comparator.
5. Op amp –Differentiator.
6. Op amp Integrator.
7. First order active low pass filter.
8. First order active high pass filter

Demonstration experiments

1. Laser experiments: straight edge, single slit, ruler grating
2. Optical Fiber: transmission of signal

3. Concept of beats
4. Coupled oscillations and resonance
5. Wave form generator using Op-amp
6. PC simulations: graph, curve fitting etc.
7. Straight edge Fresnel diffraction
8. Double refraction
9. Michelson's Interferometer

Mini Projects.

References:

- D. Chattopadhyay, PC. Rakshit & B. Saha. (6th Edition) Advanced course in Practical Physics Book& Allied Pvt. Ltd.
- Harnam Singh S. BSc Practical Physics Chand & Co. Ltd. – 2001
- Samir Kumar Ghosh A Text book of advanced Practical Physics –, New Central Book Agency – (3rd edition)
- CL Arora (Ist Edition) B Sc. Practical Physics –– 2001 S. Chand & Co. Ltd.
- CL Squires – (3rd Edition) Practical Physics –Cambridge University Press.
- D C Tayal University Practical Physics –. Himalaya Publication.
- Worsnop & Flint. Advanced Practical Physics
- Main Reference: Manual provided by Department of Physics