SYLLABUS

FOR

SEM V & VI

Program: B.Sc.

Course: Physics

From

Academic year

2023-24

Board of studies in Physics

Undergraduate and Post graduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Dr. Deepak More	Chairman	K. J. Somaiya college of science and commerce
Subject Expert nominated by Vice-Chancellor			
1	Dr. Anita Kanwar	Principal	VES College, Chembur
Subject experts			
1	Dr. Nigvendra Sharma	Head of the Department	Maharashtra College of Arts, Science & Commerce
2	Dr Dinesh Kala	Head of the Department	G N Khalsa College of Arts, Science & Commerce
3	Dr. Paresh Joshi	Chairman, BASE	HBCSE
Representative from Industry/corporate sector/allied area			
1	R. Venkataraman	Director	Tej Control System PVT LTD. Thane 400064
Meritorious Alumnus			
1	Vikrant Jadhav	Founder	Panacea Intech PVT LTD
Two experts from other than the parent University			
1	Raghunath Chelakkot	Associate Professor	Department of Physics, IITB, Mumbai
2	R. R. Deshmukh	Professor	Department of physics, ICT, Mumbai
Faculty of the specialisation			
1	Dr. Deepak More	Associate Professor	K. J. Somaiya college of science and commerce
2	Dr. Geeta Nair	Associate Professor	K. J. Somaiya college of science and commerce

3	Mr. A M Shaker	Associate Professor	K. J. Somaiya college of science and commerce
4	Dr. Jitendra Pendharkar	Associate Professor	K. J. Somaiya college of science and commerce
5	Dr. Smita Survase	Associate Professor	K. J. Somaiya college of science and commerce
6	Mr. Anshul Gupta	Assistant Professor	K. J. Somaiya college of science and commerce
7	Mr. Deepak Jalla	Assistant Professor	K. J. Somaiya college of science and commerce
8	Mr. Amit More	Assistant Professor	K. J. Somaiya college of science and commerce
9	Dr. Pallavi Raote	Assistant Professor	K. J. Somaiya college of science and commerce
10	Mr. Ketankumar Gayakwad	Assistant Professor	K. J. Somaiya college of science and commerce
11	Dr. Rucha Naik	Assistant Professor	K. J. Somaiya college of science and commerce
12	Dr. Shruti Barve	Assistant Professor	K. J. Somaiya college of science and commerce
13	Mr. Ranjit Yadav	Assistant Professor	K. J. Somaiya college of science and commerce

Acknowledgement

At the outset, I would like to thank our, Principal Dr. Pradnya Prabhu for her guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Physics for the long and arduous work they have put in during the compiling of the restructured syllabus.

Dr. Deepak More

Chairperson

Board of Studies in Physics

Graduate Attributes

After the successful completion of modules in different courses of B.Sc. PHYSICS, the learner will be able to:

GA 1: Apply physics concepts and acquired skill sets to novel and unknown problems in order to establish an effective approach or strategy for dealing with them.

GA 2: Explore and derive quantitative data in the realms of physics.

GA 3: Collect, analyze, and interpret scientific data in the realms of physics using modern experimental apparatus and research methods.

GA 4: Develop Psycho-motive, analytical, observation skills through lab work

GA 5: Approach any real life problem with proper assumption, logic and constraints.

GA 6: Prepare for jobs, career development, and lifelong learning in Physics, by using acquired ICT skills, physics practical skills, and mathematical skills.

Programme Learning outcomes

After the successful completion of modules in different courses of B.Sc. physics the learner will be able to:

PLO I: Apply principles of physics on various physical phenomenon.

PLO II: Calculate physical parameters from the available data.

PLO III: Analyse and interpret the data in various forms (numerical/graphical)

PLO IV: Development of Psycho-motive, analytical, observation skills through lab work.

PLO V: Approach any real life problem with proper assumption, logic and constraints.

PLO VI: Compete and succeed in various qualifying examinations in various related fields. (Higher education/software/industry)

Content

Sr.No	Semester	Course number	Course Code	Course title
Core Course (CC)				
1	V	CC I	23US5PHCC1STP	Statistical Physics
2		CC II	23US5PHCC2SSP	Solid State Physics
3		CCP I	23US5PHCCPI	Based on CC I and CC II
4		CC III	23USPHCC3ATP	Atomic Physics
5		CC IV	23USPHCC4ELD	Electrodynamics
6		CCP II	23US5PHCCPII	Based on CC III and CC IV
7	VI	CC I	23US6PHCC1CLM	Classical Mechanics
8		CC II	23US6PHCC2ELE	Electronics
9		CCP I	23US6PHCCPI	Based on CC I and CC II
10		CC III	23US6PHCC3NPH	Nuclear Physics
11		CC IV	23US6PHCC4STR	Special Theory of Relativity
12		CCP II	23US6PHCCPII	Based on CC III and CC IV
	Discipline Specific Electives (DSE)			
1	V	DSE I	23US5PHDS1AEL	Analog Electronics
2		DSE II	23US5PHDS2DEI	Digital Electronics and instrumentation
3		DSE III	23US5PHDS3ELC	Electronics Communication
4				
5		DSEP	23US5PHDSP	Practical Based on DSE Courses
6	VI	DSE I	23US6PHDS1MAP	8085 microprocessor architecture, programming and applications
7		DSE II	23US6PHDS2CPG	C Programming
8		DSE III	23US6PHDSAOP	Applied Optics

9		DSEP	23US6PHDSP	Practical Based on DSE Courses
Skill Enhancement Course (SEC)				
1	V	SEC I	23US5PHSEIMME	Mathematical Methods
2		SEC II	23US5PHSE2REH	Renewable Energy Harvesting
3	VI	SEC I	23US6PHSE1ECN	Electrical circuits and Network skills
Ability Enhancement Compulsory Course (AECC)				
1	V	AECC I	23US5AE1EVS	Environmental Science
2	VI	AECC I	23US6AE1EVS	Environmental Science

Detailed B.Sc. Physics Syllabus

T. Y. B.Sc. Syllabus with effect from the Academic year 2023-24

Syllabus - T. Y. B.Sc. Physics

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 V										
Core courses THEORY										
I	Statistical Physics	23US5PHCC1STP	2	30	36	3	12	40	60	100
II	Solid State Physics	23US5PHCC2SSP	2	30	36	3	12	40	60	100
III	Atomic Physics	23USPHCC3ATP	2	30	36	3	12	40	60	100
IV	Electrodynamics	23USPHCC4ELD	2	30	36	3	12	40	60	100
Core courses PRACTICAL										
CCPI	Core Practical I	23US5PHCCPI	2	75	90			40	60	100
CCPII	Core Practical II	23US5PHCCPII	2	75	90			40	60	100
Discipline Specific Electives (DSE)										
DSEI	Analog Electronics	23US5PHDS1AEL	2	30	36	3	12	40	60	100
DSEII	Digital Electronics and instrumentation	23US5PHDS2DEI	2	30	36	3	12	40	60	100
DSEIII	Electronics Communication	23US5PHDSELC	2	30	36	3	12	40	60	100
Skill Enhancement Course (SEC)										
SEC1	Mathematical Methods	23US5PHSEIMME	2	24	30	2	12	40	60	100
SEC2	Renewable Energy Harvesting	23US5PHSE2REH	2		24	2	12	40	60	100

SEMESTER VI										
Core courses THEORY										
I	Classical Mechanics	23US6PHCC1CLM	2	30	36	3	12	40	60	100
II	Electronics	23US6PHCC2ELE	2	30	36	3	12	40	60	100
III	Nuclear Physics	23US6PHCC3NPH		2	30	36	3	12	40	60
IV	Special Theory of relativity	23US6PHCC4STR		2	30	36	3	12	40	60
Core courses PRACTICAL										
CCPI		23US6PHCCPI	2	75	90			40	60	100
CCPII		23US6PHCCPII	2	75	90			40	60	100
Discipline Specific Electives (DSE)										
DSEI	8085 micro processor architecture programming and applications	23US6PHDS1MAP	2	30	36	3	12	40	60	100
DSEII	C Programming	23US6PHDS2CPG	2	30	36	3	12	40	60	100
DSEIII	Applied Optics	23US6PHDSAOP	2	30	36	3	12	40	60	100
Skill Enhancement Course (SEC)										
SECI	Electrical circuits and Network skills	23US6PHSE1ECN	2	30	24	2	12	40	60	100

T.Y. B. Sc. (Physics) SEMESTER V

Core Course- I

COURSE TITLE: Statistical Physics

COURSE CODE: 23US5PHCC1STP [CREDITS - 02]

Course Learning Objective
After the successful completion of the Course, the learner will be able to: 1. Understand the scope of statistical concept for solving the equation of thermal mechanics. 2. Demonstrate the thermodynamical relations. 3. Understand the concepts of MB,BE and FD distribution.

Module 1	**Description of a System**	[12L]
Learning Objectives: The module is intended 1. To describe elementary statistical Physics to learners 2. To establish the statistical background of thermodynamics.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand the need to use statistics to describe systems containing huge numbers of particles. 2. Understand the statistical foundations of Equilibrium.		
1.1	Description of a system: Why statistical approach, Particle-states, System- states, Microstates and Macro states of a system.	[4L]
1.2	Equilibrium and Fluctuations, Irreversibility, The equiprobability postulate, Statistical ensemble, Number of states accessible to a system, Phase space.	[4L]

1.3	Reversible processes. Phase space, The probability of a distribution, The most probable distribution	[4L]
Module 2	**Thermal and adiabatic interactions**	**[12L]**
Learning Objectives: The module is intended to 1. Describe statistical interpretations of thermal interactions. 2. Understand thermodynamically potentials		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand & be able to apply Classical Thermodynamics to simple problems. 2. Learn how to solve thermodynamics problems related to thermo-dynamical relations		
2.1	Thermal interaction, Canonical distribution, Energy fluctuations, Entropy of a system in a heat bath, Helmholtz free energy	[4L]
2.2	Adiabatic interaction and enthalpy, General interaction and the first law of thermodynamics, Infinitesimal general interaction, Gibbs free energy, Phase transitions	[8L]
Module 3	**Statistical Mechanics**	**[12L]**
Learning Objectives: The module is intended to 1. Describe concepts of bosons and fermions. 2. Obtain statistical formulae for BE and FD statistics		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand the quantum statistical physics of Fermions & Bosons 2. Understand the statistical foundations of Equilibrium Thermodynamics 3. Apply Fermion & Boson Statistics to various many particle problems		
3.1	Statistical Mechanics :, Maxwell-Boltzmann statistics, Quantum Statistics : Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula	[6L]

3.2	The Planck radiation formula, Fermi-Dirac statistics, Comparison of results, Transition between states	[6L]

References:

1. S. Lokanathan and R. S. Gambhir (2008). An introduction to Statistical and Thermal Physics; NewDelhi: Prentice Hall of India.
2. Arthur Beiser, Perspectives of Modern Physics; (Mc Graw Hill International).
3. Sinha H P (2005) Thermal and Statistical Physics. Agra: Ram Prasad and Sons.

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V

Core Course- I

COURSE TITLE: Statistical Physics

COURSE CODE: 23US5PHCC1STP [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Core Course- II

COURSE TITLE: Solid State Physics

COURSE CODE: 23US5PHCC2SSP [CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Interpret Electrical properties of metals, Fermi-Dirac statistics and electronic distribution in solids. 2. Describe phenomenon of Superconductivity and types, effects associated with superconductivity 3. Study band theory of solids and interpret the Kronig- Penney model and Brillouin zones. 4. Describe conductivity related features of electrons and Holes in an Intrinsic Semiconductor, and Hall Effect. 5. Analyze Qualitative theory of the p-n junction, temperature dependence of p-n characteristics, Diode resistance.

Module 1	**Electrical properties of metals**	[12L]

Learning Objectives:
The module is intended to

1. Describe the classical free electron theory.
2. Derive Ohm"s law and Wiedemann Franz Law.
3. Explain failure of classical free electron theory.
4. Describe quantum free electron theory.
5. Derive equation for Fermi energy.
6. Explain Fermi distribution function.
7. Explain how quantum free electron theory overcomes failures of classical free electron theory.

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

1. List various electrical properties of metal.
2. State assumptions of classical free electron theory and its success in verifying

Ohm"s law and Wiedemann Franz law. 3. Explain failures of classical free electron theory. 4. Define Fermi function and Fermi energy. 5. Derive equation for Energy density states. 6. Describe electrical conductivity on the basis of Quantum free electron theory. 7. Explain success of Quantum free electron theory in overcoming failures of classical free electron theory		
1.1	Electrical properties of metals : Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path	[4L]
1.2	Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy	[4L]
1.3	The Fermi distribution function, Heat capacity of the electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations	[4L]
Module 2	**Super conductivity and band theory of solids**	[12L]
Learning Objectives: The module is intended to 1. evaluate and analyze the electrical and optical properties of solids 2. analyze electron transport and energy related problems by applying quantum mechanical principles		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Students will be able to determine the crystal structure by analysis of XRD data 2. Students will be able to evaluate and analyze the electrical and optical properties of solids		
2.1	Superconductivity: A survey, Mechanism of Superconductors, Effects of magnetic field, The Meissner effect, the penetration depth, Type I and Type II Superconductors. BCS theory.	[5L]
2.2	Band theory of solids, The Kronig- Penney model (Omit eq. 6.184 to 6.188), Brillouin zones, Number of wave functions in a band, Motion	[7L]

	of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors.	
Module 3	Conduction in semiconductors	[12L]

Learning Objectives:
The module is intended to

1. Have knowledge about the physics of semiconductor materials.
2. Describe various properties of semiconductor materials using mathematical equations.
3. Analyse the characteristics and theories in semiconductor materials in terms charge carriers and energy bands.
4. Able to calculate charge carrier concentration and change due to temperature.
5. Evaluate the charge and electric field distribution in a p-n junction.
6. Formulate the sequence of events of a p-n junction under forward bias and reverse bias.

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

1. Know the physics of semiconductor,
2. Differentiate intrinsic, extrinsic semiconductor
3. Describe their behaviour in various conditions.

3.1	Conduction in Semiconductors. Electrons and Holes in an Intrinsic Semiconductor, Conductivity, Carrier concentrations, Donor and Acceptor impurities, Charge densities in a Semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, The Hall effect.	[5L]
3.2	Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance. Semiconductor nanoparticle: effect on band gap energy	[7L]

References:

1. Pillai S.O (2015): Solid State Physics 7/e New Age International. (SOP)
2. Millman, Halkias & Satyabrata Jit (2015): Electronic Devices and Circuits 2/e : Tata McGraw Hill.
3. Pillai S.O(2012): Modern Physics and Solid State Physics : Problems and solutions
4. T. Pradeep (2007) : Nano: The essentials: Tata McGraw Hill
5. Solid State Physics: A. J. Dekker, Macmillan India Ltd.

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T.Y. B. Sc. (Physics) SEMESTER V

Core Course- II

COURSE TITLE: Solid State Physics

COURSE CODE: 23US5PHCC2SSP [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	06	08	08	08	30
II	05	10	08	07	30
III	08	08	08	06	30
Total marks per objective	19	26	24	21	90
% Weightage	21 %	29%	27 %	23 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Core Course- III

COURSE TITLE: Atomic Physics

COURSE CODE: 23US5PHCC3ATP [CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Apply quantum theory (STIE) to Hydrogen atom. 2. Understand the concept of spin of electron, using Stern Gerlach experiment. 3. Understand Vector atom model. 4. Evaluate the selection rules for atomic transitions. 5. Evaluate the expression for change in wavelength of spectrum because of applied, strong and weak magnetic field. 6. Understand the effect of moderate magnetic field on the spectrum.

Module 1	**Hydrogen Atom**	[12L]
Learning Objectives: The module is intended to 1. Understand use of quantum mechanics at atomic level. 2. Derive Schrodinger equation for hydrogen atom in spherical polar coordinate. 3. Estimate the Eigen values of wave functions for different operators. 4. Explain spin of electron with Stern Gerlach experiment.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Solve Schrodinger equation using spherical polar coordinates by using separation of variables. 2. Illustrate the physical interpretation of quantum numbers. 3. Explain the concept of probability density of electron in hydrogen atom for various states. 4. Describe the construction of Stern Gerlach experiment for demonstrating spin of electron.		
1.1	Hydrogen atom: Schrödinger"s equation for Hydrogen atom,	[9L]

	Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part).	
1.2	Electron Spin: The Stern-Gerlach experiment	[3L]
Module 2	**Spin orbit coupling & Vector atom model**	[12L]

Learning Objectives:
The module is intended to

1. Differentiate between the symmetric and anti-symmetric wave functions.
2. Understand the spin orbit coupling in Hydrogen atom.
3. Explain the vector atom model with possible schemes.
4. Derive the selection rules in hydrogen spectrum.

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

1. Understand symmetric and asymmetric wavefunctions with examples.
2. Calculate the shift in wavelength observed in the hydrogen spectrum due to spin-orbit coupling.
3. Explain the LS coupling and JJ coupling.
4. Derive the expression for change in the average position of electron and frequency of light emitted in the process (Bohr's Third postulate)
5. Solve problems based on vector atom model

2.1	Pauli's Exclusion Principle Symmetric and Anti-symmetric wave functions. Spin orbit coupling, Hund's Rule, Total angular momentum, Vector atom model, L-S and J-J coupling.	[8L]
2.2	Origin of spectral lines, Selection rules	[4L]
Module 3	Atom interaction with external magnetic field	[12L]

Learning Objectives:
The module is intended to

1. Learn change in atomic energy states due to applied external magnetic field.
2. Understand allowed transitions under external magnetic field.
3. Understand the changes in the states and transitions, with respect to the magnetic field strength.

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

1. Normal Zeeman effect under strong magnetic field.
2. Anomalous Zeeman effect under weak magnetic field.
3. Paschen Back effect under moderate magnetic field.

3.1	Effect of Magnetic field on atoms, the normal Zeeman Effect and its explanation (Classical and Quantum), The Lande g factor, Anomalous Zeeman effect.	[7L]
3.2	Paschen-Back effect, Paschen-Back effect of principal series doublet, Selection rules for Paschen-Back effect	[5L]

References:

1. B: Arthur Beiser: Perspectives of Modern Physics, McGraw Hill.
2. SA: H. Semat & J. R. Albright: Introduction to Atomic & Nuclear Physics, (5th Ed.) Chapman & Hall.
3. W: H. E. White: Introduction to Atomic Spectra: McGraw Hill

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T.Y. B. Sc. (Physics) SEMESTER V
Core Course- III
COURSE TITLE: Atomic Physics
COURSE CODE: 23US5PHCC3ATP [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Core Course- IV

COURSE TITLE: Electrodynamics

COURSE CODE: 23US5PHCC4ELD [CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Apply Gauss's law in free space and matter to solve different electrostatic problems. 2. Understand the concept of potential for various charge distributions 3. Define susceptibility, permittivity and dielectric constant and understand physical significance of bound charges. 4. Apply Ampere's law to different magnetostatic problems and understand the physical significance of bound currents. 5. Study the amperes law in material medium 6. Interpret Maxwell's equations in free space and matter 7. Understand the Poynting`s theorem and continuity equation 8. Derive the expression for energy and momentum in electromagnetic waves and correlate it to Poynting vector 9. Study reflection and transmission of EM waves at normal incidence at the boundary between two media.

Module 1	Electrostatics	[12L]

Learning Objectives:
The module is intended to

1. Understand Gauss's law in free space and to analytically apply it to solve different problems.
2. Derive the divergence and curl of electric field
3. Apply Gauss's law to matter and understand bound charges. Understand use of quantum mechanics at atomic level.

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

1. State Gauss's law in free space and matter and solve numerical based on it.
2. Derive the divergence and curl of electric field
3. State Poisson's and Laplace's equation and derive expression for potential of a charge.
4. Define susceptibility, permittivity and dielectric constant and the relation between them.

1.1	Gauss law, The divergence of E, Applications of Gauss law, The curl of E	[3L]
1.2	Introduction to potential, Comments on potential, Poisson's equation and Laplace's equation, The potential of a localized charge distribution	[4L]
1.3	Dielectrics, Induced Dipoles, Polarization, Bound charges and their physical interpretation, Gauss" law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant,	[5L]
Module 2	**Magnetostatics**	[12L]

Learning Objectives:
The module is intended to

1. Solve problems based on Ampere's law
2. Interpret bound currents and the concept of magnetization
3. Understand Maxwells equation and its significance in electrodynamics

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

1. Solve problems based on Ampere's law
2. Derive the expression for divergence and curl of magnetic field.
3. Interpret the concept of bound currents and extend Ampere's law to magnetic materials
4. Interpret Maxwell's equations

2.1	The Divergence and Curl of B, Applications of Ampere"s Law	[3L]
2.2	Dia-magnets Paramagnets Ferro magnets, Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility	[4L]

	and permeability.	
2.3	Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Maxwell's equations in matter, Boundary conditions	[5L]
Module 3	Electromagnetic wave	[12L]

Learning Objectives:
The module is intended to

1. Understand the concept of electromagnetic waves.
2. Derive the Poynting's theorem, energy and momentum in electromagnetic waves
3. Explain the reflection and transmission of electromagnetic waves in different media

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

1. Derive continuity equation and Poynting`s theorem based on energy conservation
2. Write wave equations for electric and magnetic fields.
3. Estimate energy and momentum in electromagnetic waves
4. Solve simple problems on electromagnetic waves in different media.

3.1	The continuity equation, Poynting's theorem	[2L]
3.2	Electromagnetic waves in vacuum, electromagnetic waves in matter, the wave equation for E and B, Monochromatic Plane waves, Energy and momentum in electromagnetic waves.	[5L]
3.3	Electromagnetic waves in matter, Reflection and transmission of EM waves at normal incidence.	[5L]

References:

1. DG: David J. Griffiths (3rd Ed) Introduction to Electrodynamics : Prentice Hall of India.
2. Electricity and magnetism: A S Mahajan, A A Rangwala Mc Graw Hill
3. Classical Electrodynamics: David Jackson (3rd Edition) John Wiley and Sons
4. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat., Narosa Publishing

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V
Core Course- IV
COURSE TITLE: Electrodynamics
COURSE CODE: 23US5PHCC4ELD [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	10		30
II	10	10	10		30
III	06	10	10	04	30
Total marks per objective	26	30	30	04	90
% Weightage	29 %	34 %	33 %	4 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Discipline Specific Elective Course- I

COURSE TITLE: Analog Electronics

COURSE CODE: 23US5PHDS1AEL **[CREDITS -** 02**]**

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Explain principle of operation of various sensors 2. Understand the concepts, working principles and key applications of linear integrated circuits. 3. Analyse the performance characteristics of each instrument		
Module 1	**Transducers and its applications**	[12L]
Learning Objectives: The module is intended to 1. provide basic knowledge about the various sensors and data acquisition systems applied in Wireless sensor network.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. explain principle of operation for various sensors. 2. describe functional blocks and applications of sensor in various areas.		
1.1	Introduction to Transducers.	[2L]
1.2	Temperature measurements, Resistance thermometer, thermocouple & thermistor	[2L]
1.3	Pressure & Displacement Transducers: Strain Gauges (derivation of gauge factor is not expected), LVDT, Capacitive transducers	[3L]
1.4	Optical Transducers Photo –diode, photo transistor, Photo multiplier tube,	[2L]
1.5	Transducers Applications :Automotive sensors, Home appliance sensors, Medical diagnostic sensors	[3L]
Module 2	**Display Devices and power supplies**	[12L]

Learning Objectives:
The module is intended to

1. learn about Various display device and Various types of power supplies

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

1. Understand the fundamentals and areas of applications for the integrated circuits & Display devices
2. Analyse important types of power supplies
3. Demonstrate the ability to design practical circuits that perform the desired operations.
4. Understand the differences between theoretical, practical & simulated results in integrated circuits.

2.1	Display devices: LED, LCD, and Seven segment LED display, BCD to seven segment decoder / driver.	[4L]
2.2	Linear and switching regulators Monolithic linear IC voltage Regulators. (LM 78XX, LM 79XX, LM 317).	[4L]
2.3	Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations)	[4L]
Module 3	Measuring Instruments	[12L]

Learning Objectives:
The module is intended to

1. Get the theoretical background of cathode ray oscilloscope
2. Learn the conversion of Analog signal to digital signal by various methods

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

1. Analyse the performance characteristics of each instrument
2. Explain the basic features of oscilloscope and different types of oscilloscopes
3. Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology

3.1	Cathode Ray Oscilloscope: Introduction, CRO block diagram, CRT connection, Vertical amplifier, Basic function of sweep generator,	[8L]

	Horizontal deflection system, Triggered sweep, Trigger Pulse, Delay line. Dual trace CRO.	
3.2	Analog to digital conversion:--Simultaneous Conversion methods Counter method, successive approximation method	[4L]

References:

1. D.Patranabis Sensors and Transducers 2nd edition.
2. Albert D. Helfrick& William D. Cooper (PHI) Edition: Modern Electronic Instrumentation & Measurement Techniques.
3. K: H. S. Kalsi, 2nd Edition Electronic Instrumentation by, Tata McGraw Hill.
4. T: G. L. Tokheim (6th Editon)Digital electronics (Tata McGraw Hill)
5. C & D: Coughlin & F. F. Driscoll "OPAMPs and linear integrated circuits 6th Edition), Eastern Economy Education, PHI
6. G R. A. Gayakwad: OPAMPs & linear integrated circuits,(4th Edition, PHI)

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V
Discipline Specific Elective Course- DSEI
COURSE TITLE: Analog Electronics
COURSE CODE: 23US5PHDS1AEL **[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	05	10	10	5	30
II	05	10	10	5	30
III	10	10	10		30
Total marks per objective	20	30	30	10	90
% Weightage	22 %	34 %	34 %	10 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Discipline Specific Elective Course- II

COURSE TITLE: Digital Electronics and instrumentation

COURSE CODE: 23US5PHDS2DEI **[CREDITS -** 02**]**

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Analyze a digital logic circuit and implement it to solve real-life problems. 2. Analyze and design combinational and sequential logic circuits. 3. Study NAND and NOR logic families with TTL and CMOS devices.		
Module 1	**Data Processing Circuits**	[12L]
Learning Objectives: The module is intended to 1. Analyse logic processes and implement logical operations using combinational logic circuits. 2. Understand concepts of sequential circuits and to Analyse sequential systems in terms of state machines		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Develop a digital logic and apply it to solve real life problems. 2. Analyse, design and implement combinational logic circuits. 3. Study the conversion of digital data.		
1.1	Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD-to-decimal Decoders, and Seven segment Decoders, Encoders.	[6L]
1.2	D/A conversion: Variable resistor Networks binary ladders D/A converters, D/A accuracy and resolution.	[6L]
Module 2	**Registers and Counters**	[12L]
Learning Objectives: The module is intended to		

1. Learn different types of Registers and digital counters.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Develop a digital counter which will be able to use for real life counting 2. Learn how to shift data at the appropriate location		
2.1	Registers: Types of registers, Serial In-serial Out, Serial In-Parallel Out, Parallel In – Serial Out, Parallel In –Parallel Out, Applications of Shift Registers	[6L]
2.2	Counters: Ripple Counter, Synchronous Counters, Ring Counters, And Other Counters.	[6L]
Module 3	Digital Integrated Circuit	[12L]
Learning Objectives: The module is intended to 1. Know about NAND and NOR logic families with TTL and CMOS devices.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Distinguish between working of logic families with TTL and CMOS gates.		
3.1	Digital Integrated Circuits: Switching Circuits, Logic families: Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices	[8L]
3.2	MOS inverters, CMOS NAND and NOR gates, CMOS characteristics	[4L]
References: 1. ML: Malvino and Leach (6th Ed) Digital Principles and Applications (TMH). 2. MB : Malvino and Brown (3rd Ed) Digital Computer Electronics		

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V
Discipline Specific Elective Course- DSEII
COURSE TITLE: Digital Electronics and instrumentation
COURSE CODE: 23US5PHDS2DEI **[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	8	7	9	6	30
II	9	7	8	6	30
III	6	9	6	9	30
Total marks per objective	23	23	23	21	90
% Weightage	25.55 %	25.55 %	25.55 %	23.33 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Discipline Specific Elective Course- III

COURSE TITLE: Electronics Communication

COURSE CODE: 23US5PHDS2DSELC [**CREDITS** - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Define communication and explain the different steps in communication & different types of communication system. 2. Distinguish between information and message. 3. Explain need for modulation. 4. Classify electromagnetic spectrum as MF,HF,VHF and UHF. 5. Explain different sources of noise & Calculate noise levels

Module 1	**Introduction to Communication System**	[12L]

Learning Objectives:
The module is intended to

1. Define communication and explain the different steps in communication & different types of communication system.
2. Distinguish between information and message.
3. Explain need for modulation.
4. Classify electromagnetic spectrum as MF,HF,VHF and UHF.
5. Explain different sources of noise & Calculate noise levels

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

1. Define the word information as it applies to subject of communication.
2. Various elements of communication system.
3. Understand the use of modulation as it applies to transmission.
4. Know about electromagnetic spectrum and basic terminologies in communication system& different types of communication system.

5. Understand the different sources of noise. 6. Explain how to measure signal to noise ratio and noise figure and their necessity.		
1.1	Introduction to Communication System: Elements of communication system, need for modulation, electromagnetic spectrum and typical applications, types of communication systems, classification of communication system.	[9L]
1.2	Noise: Introduction, external noise, internal noise, noise figure	[3L]
Module 2	**Amplitude modulation techniques**	[12L]
Learning Objectives: The module is intended to 1. Know the elements of analog communication. 2. Understand the theory of amplitude modulation techniques. 3. Explain different approaches for the generation of AM, DSBSC and SSB signals.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Distinguish between analog and digital communication 2. List and explain the different elements of analog communication. 3. Mention different components of AM, DSBSC and SSB wave. 4. Derive the expression for peak amplitude, instantaneous voltage and total power of AM, DSBSC and SSB wave. 5. Explain the difference between AM, DSBSC and SSB wave. 6. Describe the AM wave generation process using analog multiplier and diode as non-linear resistor. 7. Describe the DSBSC wave generation process using analog multiplier and balanced modulator. 8. Describe the SSB wave generation process using analog multiplier and frequency discrimination methods.		
2.1	Amplitude modulation techniques: Elements of analog communication, Amplitude modulation (AM) techniques, Double side band suppressed carrier (DSBSC) technique, Single sideband (SSB) technique, Generation of AM signal, Generation of DSBSC signal, generation of SSB signal.	[12L]

Module 3	Modulation Techniques	[12L]

Learning Objectives:
The module is intended to

1. Describe the theory of amplitude modulation & generation of frequency modulation.
2. Understand the difference between continuous wave and pulse analog modulation techniques.
3. Explain the sampling process, PAM, PWM and PPM techniques.
4. How to demodulate pulse analog modulated techniques

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

1. Explain what is the effect of modulating signal amplitude and modulating signal frequency on FM wave?.
2. Give the differences and similarities between FM and PM.
3. Describe direct and indirect method of FM generation and its limitations.
4. Describe the sampling process.
5. Describe the generation & demodulation of PAM, PWM and PPM signals.
6. Make a comparison between PAM, PWM and PPM modulation scheme

3.1	Angle modulation techniques: Theory of angle modulation techniques, Generation of frequency modulation (FM and Direct methods)	[5L]
3.2	Pulse modulation techniques: Introduction, Pulse analog modulation techniques -Pulse amplitude modulation, Pulse width modulation, Pulse position modulation, Demodulation of pulse analog modulated signals.	[7L]

References:

1. KD : George Kennedy, Bernard Davis, S R M Prasanna -Electronic communication systems (6th Ed)

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V
Discipline Specific Elective Course- DSEIII
COURSE TITLE: Electronics Communication
COURSE CODE: 23US5PHDS2ELC [**CREDITS - 02**]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Skill Enhancement Course - I

COURSE TITLE: Mathematical Methods

COURSE CODE: 23US5PHSE1MME **[CREDITS -** 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Demonstrate competence with the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and Diagonalization. 2. Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients. 3. Solve a Cauchy problem for the wave or diffusion equations using the Fourier Transform.

Module 1	**Matrices**	[12L]

Learning Objectives:
The module is intended to

1. Understand the linear equations, vector spaces, matrices linear transformations, determinants, Matrices, etc.
2. Learn to use Laplace transform methods to solve differential equations.
3. Introduce the Fourier series and its application to the solution of partial differential equations

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

1. Learn the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations
2. Apply the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients

1.1	Addition and Multiplication of Matrices. Null Matrices. Diagonal, Scalar and Unit Matrices. Upper Triangular and Lower-Triangular Matrices	[4L]
1.2	Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices.	[4L]
1.3	Adjoint of a Matrix. Inverse of a Matrix by Adjoint Method. Orthogonal and Unitary Matrices. Trace of a Matrix. Eigen-values and Eigenvectors. Cayley- Hamilton Theorem. Diagonalization of Matrices	[4L]
Module 2	**Fourier and Laplace transforms**	[12L]

Learning Objectives:
The module is intended to

1. Use Fourier transform and Laplace transform to solve equations.

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

1. Apply the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.

2.1	Fourier transforms: Introduction, Formal development of the complex Fourier transform,	[5L]
2.2	Cosine and Sine transforms, The transforms of derivatives.	[3L]
2.3	Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem.	[4L]

References:

1. Erwin Kreyszig (Wiley Eastern Limited,1985) Advanced Engineering Mathematics
2. Charlie Harper. (P.H.I., 1995) Introduction to Mathematical Physics
3. B S Grewal, Khanna Publishers (2000) Higher Engineering Mathematics
4. H.K.Dass Mathematical Physics

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V
Skill Enhancement Course- SEC I
COURSE TITLE: Mathematical Methods
COURSE CODE: 23US5PHSE1MME **[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	15	15	10	5	45
II	15	15	10	5	45
Total marks per objective	30	30	20	10	90
% Weightage	34 %	33 %	22 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER V

Skill Enhancement Course - II

COURSE TITLE: Renewable Energy harvesting

COURSE CODE: 23US5PHSE2REH **[CREDITS -** 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Describe sources and uses renewable and non-renewable energy. 2. Provide examples of common types of renewable and non-renewable resources. 3. Understand and explain general ways to save energy at a personal, community and global level. 4. Understand and explain, in general how passive solar heating, hydropower and wind power work. 5. Understand the benefits and disadvantages to using renewable resources.		
Module 1	**Introduction**	[12L]
Learning Objectives: The module is intended to 1. Outline and brief description, including fundamentals, of the different renewable energy technologies, wind, solar, bioenergy, hydro, and geothermal energy; 2. Overview of renewable energy technologies and applications;		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand the depth and importance of nonconventional energy 2. Correlate renewable energy with sustainable development		
1.1	Introduction: Forms of Energy, Present-day energy use Energy devices and Conversions, Energy problem, Environmental impact, Limitations and side effects of conventional sources, Way towards Sustainable Development Environmental impact of renewable energy sources	[4L]

1.2	Different ways of generating renewable energies, Solar energy, Wind energy, Tidal energy, Wave energy, Ocean thermal energy conversion,	[4L]
1.3	Hydroelectricity, Hydrogen energy, Magneto-hydro dynamic (MHD) power generation: Materials, principle and advantages, Piezoelectric Energy generation, Thermoelectric power: Materials, power generation, applications Thermionic generation of power	[4L]
Module 2	**Widely used non-conventional energy sources**	**[12L]**

Learning Objectives:
The module is intended to

1. Describe Solar energy harvesting in detail
2. Give overview of wind energy.

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

1. Identify strengths and weaknesses of different renewable technologies.

2.1	Solar Energy Introduction, Solar energy collectors, Storage of solar energy, Solar pond, Applications of Solar Energy, Solar Green House, Solar Heater and Cooker Solar cell, Absorption Air Conditioning, Solar Photovoltaic, PV models and equivalent circuits Efficiency calculations	[6L]
2.2	Wind Energy Introduction and Historical Background, Designs of windmills, Wind Turbines and electrical machines required for their working, power electronic interfaces and grid interconnection topologies, Applications of wind energy	[6L]

References:

1. G. D. Rai, Non-conventional Energy Sources, New Delhi: Khanna Publishers
2. AB: S. A. Abbasi, (2006), ,,Renewable Energy Sources and Their Environmental Impact, 4th Edition, Prentice Hall of India Ref 3 Abbasi
3. MA: S. E. Manahan, (2007), Environmental Science and Technology: A sustainable

Approach to Green Science and Technology, 2nd Edition, Taylor and Francis Group Ref 5 Manahan

4. BO: Ref 1 Godfrey Boyle, (2012), Renewable Energy, Power for a sustainable future, 3rd edition, Oxford University Press and Open University.
5. S. P. Sukhatme,(2008), Solar Energy, New York: TMH Publication
6. Gilbert M. Masters, (2004), Renewable and Efficient Electric Power Systems, Wiley- IEEE Press
7. Bent Sorensen, (2004), Renewable energy: its physics, engineering, use, environmental impacts, economy, and planning aspects, 3rd Edition, Elsevier Academic Press Andre Brin, (1981), Energy and the Oceans, Ann Arbor Science Publishing Inc.

Question Paper Template

T.Y. B. Sc. (Physics) SEMESTER V
Skill Enhancement Course- SEC II
COURSE TITLE: Renewable Energy Harvesting
COURSE CODE: 23US5PHSE2REH **[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	15	15	10	5	45
II	15	15	10	5	45
Total marks per objective	30	30	20	10	90
% Weightage	34 %	33 %	22 %	11 %	100

SEMESTER V

Practical Core Course

COURSE CODE: 23US5PHP1 & 23US5PHP2

Course Learning Outcomes:

1. Understanding relevant concepts.
2. Planning of the experiments.
3. Layout and adjustments of the equipment.
4. Recording of observations and plotting of graphs.
5. Calculation of results and estimation of possible errors in the observation of results.

Regular Physics Experiments: A minimum of 8 experiments from each of the course are to be performed and reported in the journal.

Skill Experiments: Minimum 7 skills are compulsory and must be reported in the Journal. Skills will be tested during the examination through viva or Practical.

The certified journal must contain a minimum of 16 regular experiments (8 from each group) , 6 experiments from DSE (any two DSE branch, 3 from each group) and 7 Skills in semester V.

A separate index and certificate in journal are must for each semester course.

There will be three turns of three hours each for the examination of practical course

COURSE CODE: 23US5PHP1	
1	Determination of “g” by Kater‟s pendulum
2	Stefan‟s constant σ
3	Koenig‟s method
4	R.P. of grating
5	Goniometer
6	Edser‟s A pattern
7	Diameter of lycopodium powder

8	Determination of e/m
9	Surface tension of soap solution
10	Elastic constants of a rubber tube
11	Determination of wavelength by Step slit
12	R. I. by total internal reflection
13	Velocity of sound in air using CRO
COURSE CODE: 23US5PHP2	
1	Mutual inductance by BG
2	Hysteresis by magnetometer
3	Band gap of energy.
4	Diode as temperature sensor
5	Log amplifier using OPAMP
6	Wien bridge oscillator
7	Hall effect
8	LM-317 as voltage regulator
9	LM 317 as current regulator
10	M/C using BG
11	Capacitance bridge using series bridge
12	Hysteresis loop by CRO
Skill Experiments	
1	Estimation of errors.
2	Soldering advanced circuit.
3	Bread board circuit using IC"s.
4	Optical Levelling of Spectrometer.
5	Laser Beam Profile
6	Use of electronic balance: radius of small ball bearing.
7	Dual trace CRO: Phase shift measurement.
8	BG: C_1 /C_2 by comparing θ_1 / θ_2.
9	Designing of simple experiments

SEMESTER V

Practical Core Course

COURSE CODE: 23US5PHDSP

DSE1	
1	Thermistor as sensor in temperature to voltage converter using OPAMP
2	Basic Instrumentation Amplifier using 3 Op Amps coupled to resistance bridge
3	Study of LVDT characteristics
4	Study of Load Cell / Strain Guage
5	UJT Oscillator Circuit
6	Adjustable Voltage Regulator using LM 317
7	Adjustable constant Current Source using LM 317
DSE2	
1	Temperature to frequency Conversion using 555 timer
2	OPAMP ---D/A Converter weighted resistor / Ladder network
3	Shift Resister
4	Study of 8:1 Multiplexer (74LS151) and its applications
5	Study of1: 4 De-multiplexer (74LS155) and its applications.
DSE3	
1	Amplitude modulation and demodulation by opamps
2	Pulse amplitude Modulation
3	Pulse width modulation
4	Frequency Modulation and demodulation by IC 555
5	Balance modulator
6	Time division multiplexer

References:

1. H & C : Albert D. Helfrick & William D. Cooper Modern Electronic Instrumentation & Measurement Techniques (PHI)

2. C & D : Coughlin & F. F. Driscoll :“OPAMPs and linear integrated circuits” (6theditionPHI)

3. G: R.A. Gayakwad: OPAMPs and linear integrated circuits (4th edition, PHI)

4. M : A. P. Malvino: “Electronic Principles” (6th edition, PHI)

5. K : H. S. Kalsi: Electronic Instrumentation (TMH) 2nd Edition

6. M & L : Malvino and Leach: Digital Principle and Applications” (5th edition, TMH)

7. RPJ : R .P. Jain: Modern Digital Electronics 3rd edition (TMH)

T.Y. B. Sc. (Physics) SEMESTER VI

Core Course- I

COURSE TITLE: Classical Mechanics

COURSE CODE: 23US6PHCC1CLM [CREDITS - 02]

Course Learning Objective
After the successful completion of the Course, the learner will be able to: 1. Distinguish between „inertia frame of reference" and „non-inertial frame of reference". 2. Know how to impose constraints on a system in order to simplify the methods to be used in solving physics problems. 3. Know what central, conservative and central-conservative forces mathematically understand the conservative theorems of energy, linear momentum and angular Momentum. 4. Know the importance of concepts such as generalized coordinates and constrained motion. 5. Establish that Kepler"s laws are just consequences Newton"s laws of gravitation and that of motion. 6. Understand Poisson brackets, understand canonical transformations. 7. Find the linear approximation to any dynamical system near equilibrium and also know how to derive and solve the wave equation for small oscillations.

Module 1	Accelerated Frames	[12L]

Learning Objectives:

The module is intended to

1. Distinguish between „inertia frame of reference" and „non-inertial frame of reference".

Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand Central, conservative and central-conservative forces mathematically 2. Study Foucault's Pendulum		
1.1	Motion under a central force, The central force inversely proportional to the square of the distance, Elliptical orbits. The Kepler problem	[6L]
1.2	Moving origin of co-ordinates, Rotating co-ordinate systems, Laws of motion on the rotating earth, Larmor"s theorem (with proof), Foucault pendulum (Qualitative discussion and problems.	[6L]
Module 2	**Lagrange's Mechanics**	[12L]
Learning Objectives: The module is intended to 1. Learn the concepts needed for the important formalism of Lagrange's equations 2. Derive the equations using D'Alembert's principle.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Apply D'Alembert's principle 2. Apply Lagrange's equations for interpreting physical concepts		
2.1	Lagrange"s equations: D"Alembert"s principle, Generalized coordinates,	[4L]
2.2	Lagrange"s equations using D"Alembert"s principle, Examples, Systems subject to constraints, Examples of systems subject to constraints Constants of motion and ignorable coordinates.	[8L]
Module 3	**Kinematics of moving fluids & Rigid Body**	[12L]
Learning Objectives: The module is intended to 1. Introduce simple concepts from fluid mechanics		

2. Understand the dynamics of rigid bodies.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Describe conservation of mass, momentum, and energy for an ideal fluid 2. Explain Euler's Equation of motion		
3.1	Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow	[6L]
3.2	The rotation of a Rigid body : Motion of a rigid body in space, Euler"s equations of motion for a rigid body, Euler"s angles	[6L]
References: • KRS : Keith R. Symon Mechanics :. (Addision Wesely) 3rd Ed. • G, Herbert Goldstein Classical Mechanics : (Narosa 2nd Ed.) • Daniel Kleppner & Robert Kolenkow. An Introduction to Mechanics :, Tata Mc Graw Hill (Indian Ed. 2007)		

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Core Course- I
COURSE TITLE: Classical Mechanics
COURSE CODE: 23US6PHCC1CLM [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Core Course- II

COURSE TITLE: Electronics

COURSE CODE: 23US6PHCC2ELE[CREDITS - 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Explain and compare the working of multi vibrators using special application IC 555 and transistors 2. Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques. 3. Elucidate and design the linear and non-linear applications of an op-amp 4. Understand the basic electronic components FET, MOSFET and their working		
Module 1	**Multivibrators and timers**	**[12L]**
Learning Objectives: The module is intended to 1. Understand Timer and transistorised multivibrators 2. Study the applications of timers and multivibrators		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Design bistable, monostable and astable transistorised multivibrator 2. Design multivibrators using IC555		
1.1	Transistor Multivibrators: Transistor as a Switch Astable, Monostable and Bistable Multivibrators, Schmitt trigger.	[6L]
1.2	555 Timer: Block diagram, Monostable and Astable operation (with VCO), triggered linear ramp generator.	[6L]
Module 2	**Differential Amplifiers**	**[12L]**
Learning Objectives: The module is intended to 1. Analyse the differential amplifier circuits		

2. Study different applications of operational amplifier.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand the external circuit of differential amplifier& its ideal characteristics. 2. Use operational amplifier to design its various applications		
2.1	Differential Amplifier using transistor: The Differential Amplifier, DC and AC analysis of a differential amplifier, Input characteristic-effect of input bias, offset current and input offset voltage on output, common mode gain, CMRR.	[6L]
2.2	Op Amp Applications Introduction, Log amplifier, First order Active filters, Instrumentation Amplifier ,Band pass Filters, band rejection filter .Square wave &Triangular wave generator using Op-Amp	[6L]
Module 3	**Field Effect Transistors**	**[12L]**
Learning Objectives: The module is intended to 1. Describe the theory of JFET,MOSFET. 2. Use the theory to develop various application using JFET and MOSFET		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Design FET Common Source Amplifier. 2. Use FET and MOSFET for various applications		
3.1	Field effect transistors(JFET): Basic ideas, Drain curve, The transconductance curve, Biasing in the ohmic region and the active region, Transconductance, JFET common source amplifier, JFET analog switch multiplexer, voltage controlled resistor, Current sourcing.	[8L]
3.2	MOSFET : Depletion and enhancement mode, MOSFET operation and characteristics, digital switching	[4L]
References: • MB : A. P. Malvino and D.J. Bates Electronic Principles (7th Ed.) – (TMH). • VKM : V. K. Mehta and Rohit Mehta Principles of Electronics . (11th Ed.). S. Chand Publications • KVR : K .V. Ramanan Functional Electronics • G: R. A. Gayakwad,(4th Edition, PHI) OPAMPs & linear integrated circuits • S. Salivahanan, N. Suresh Kumar and A. Vallavaraj. (2nd Ed.)Electronic Devices and Circuits (Tata McGraw Hill) 1. Millman & Taub Pulse, Digital & Switching Waveform		

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Core Course- II
COURSE TITLE: Electronics
COURSE CODE: 23US6PHCC2ELE [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Core Course- III

COURSE TITLE: Nuclear Physics

COURSE CODE: 23US6PHCC3NPH [CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Explain different types of nuclear reaction and Q value with example. 2. Explain various terms, experiment and theory of Alpha decay. 3. Explain the Energetics and other concepts of Beta decay. 4. Explain the Energetics and other concepts of Gamma decay. 5. Explain nuclear radiation detection techniques. 6. Derive semi empirical formula and its applications.

Module 1	**Nuclear Reactions & Alpha Decay**	**[12L]**
Learning Objectives: The module is intended to 1. Differentiate between types of nuclear reactions. 2. Illustrate types of reactions with suitable examples. 3. Derive energetic of alpha decay based on conservation principals. 4. Derive Gamow theory of alpha decay. 5. Define range, ionization, stopping power		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Solve Q values for various nuclear reaction. 2. Derive Q value for scattering type reaction based on momentum conservation. 3. Construct decay scheme for long and short range alpha particles. 4. Derive expression for tunneling probability using Gamow theory. 5. Explain the alpha decay paradox		
1.1	Types of Nuclear Reactions, Balance of mass and energy in Nuclear Reaction, the Q-equation and Solution of Q-equation	[4L]

1.2	Alpha decay: Range of alpha particles, Disintegration energy, Alpha decay paradox: Barrier penetration (Gamow"s theory of alpha decay and Geiger- Nuttal law), Absorption of alpha particles: Range, Ionization and stopping power	[8L]
Module 2	**Beta and Gamma Decay**	**[12L]**

Learning Objectives:
The module is intended to

1. Explain the continuous nature of beta spectrum & energetic of beta decay.
2. Explain Pauli"s neutrino hypothesis.
3. Understand types of gamma decay.
4. Explain the Mossbauer Effect.

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

1. Explain the continuous and characteristics beta spectrum and appeared contradiction in it about conservation of energy.
2. List the properties of neutrino. & construction of assembly in the detection of neutrino.
3. Solve problems based on the energetic of beta decay.
4. Explain Gamma decay and internal conversion.
5. Applications of Mossbauer Effect.

2.1	Beta decay: Introduction, Continuous beta ray spectrum- Difficulties encountered in it, Pauli"s neutrino hypothesis, Detection of neutrino, Energetic of beta decay	[8L]
2.2	Gamma decay: Introduction, Internal conversion, Nuclear isomerism, Mossbauer effect.	[4L]
Module 3	**Nuclear Models**	**[12L]**

Learning Objectives:
The module is intended to

1. Explain principle of operation and construction of nuclear radiation detectors
2. Derive semi empirical mass formula.
3. Draw mass parabolas to predict stability against beta decay.
4. Derive stability limits against spontaneous fission

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

1. Derive and apply semi-empirical mass formula to find most stable odd A isobar.
2. Describe mass parabolas to predict stability against beta decay.
3. Explain the concept of mirror nuclei.
4. Explain construction and principle of operations of nuclear radiation detectors.

3.1	Nuclear radiation detectors: Proportional counter, Scintillation counter, Ionization chamber, Proportional and GM counter.	[5L]
3.2	Liquid drop model, Weizsacher"s semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. mirror nuclei	[7L]

References:

1. P : S.B. Patel Nuclear Physics: (Wiley Eastern Ltd.).
2. K : Irving Kaplan : Nuclear Physics: (2nd Ed.) (Addison Wesley).
3. G : S. N. Ghoshal : Nuclear Physics : (S. Chand & Co.)
4. Kenneth Krane (2nd Ed.) John Wiley & Sons. Modern Physics
5. N Subrahmanyam, Brij Lal. Atomic & Nuclear Physics (Revised by Jivan Seshan.) S. Chand.
6. AB : Arthur Beiser: Concepts of Modern Physics : (6th Ed.) (TMH).

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Core Course- III
COURSE TITLE: NuclearPhysics
COURSE CODE: 23US6PHCC3NPH[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Core Course- IV

COURSE TITLE: Special Theory of Relativity

COURSE CODE: 23US6PHCC4STR [CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Understand the significance of frames of reference and Michelson Morley experiment. 2. Explain Lorentz Fitzgerald contraction hypothesis ,ether drag hypothesis and postulates of special theory of relativity 3. Derive length contraction and time dilation using Lorentz transformation 4. Apply the transformation equations to arrive at transformation properties of velocity, force, momentum, energy and mass. 5. Apply the transformation equations for electric and magnetic fields 6. Use the concept of geometric representation of space and time for explaining length contraction, time dilation and twin paradox through space time diagrams.

Module 1	Experimental background of special theory of Relativity and Relativistic Kinematics	[12L]

Learning Objectives:
The module is intended to

1. Understand the significance of Michelson Morley experiment in special theory of relativity and attempts to preserve preferred frame of reference
2. Derive the transformation equations.

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

1. Understand the concept of frames of reference , ether and significance of Michelson Morley experiment
2. State the postulates of special theory of relativity.

3. Derive the Lorentz transformation equations and hence length contraction time dilation 4. Derive formula for Einstein's relativistic velocity addition.		
1.1	Galilean transformations, Attempts to locate absolute frame: Michelson- Morley experiment, Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction hypothesis and ether drag hypothesis, Attempt to modify electrodynamics, postulates of the special theory of relativity.	[6L]
1.2	Relativistic Kinematics : The relativity of Simultaneity Derivation of Lorentz transformation equations, length contraction, time dilation and meson experiment The relativistic addition of velocities	[6L]
Module 2	**Relativistic Dynamics**	**[12L]**
Learning Objectives: The module is intended to 1. Use the basic transformation equations for transformation of mass, energy and momentum between different frames of reference 2. Understand relativistic Doppler effect		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Apply the transformation equations to arrive at transformation properties of momentum, force, energy and mass 2. Derive the Einstein's mass energy formula 3. Understand the concept of aberration of light and relativistic Doppler effect		
2.1	Mechanics and Relativity, Relativistic momentum, Alternative views of mass in relativity,	[3L]
2.2	The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy,	[3L]

2.3	The transformation properties of momentum, energy and mass.	[3L]
2.4	Aberration and Relativistic Doppler effect	[3L]
Module 3	**Relativity and Electromagnetism, The Geometric Representation of Space-Time**	**[12L]**

Learning Objectives:
The module is intended to

1. Use the transformation equation for electric and magnetic field and apply it to various cases.
2. Understand the concept of space and time through diagrams.

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

1. Derive the Lorentz transformation equations for electric and magnetic fields
2. Derive the expression for force and fields of moving charges
3. Represent the concept of simultaneity, length contraction and time dilation through space time diagrams.

3.1	Relativity and Electromagnetism :The interdependence of Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, the invariance of Maxwell"s equations	[7L]
3.2	The Geometric Representation of Space-Time: Space-Time Diagrams, Simultaneity, Length contraction and time Dilation, twin paradox, Time order and space separation of events	[5L]

References:

1. Robert Resnick (Wiley Student Edition) Introduction to Special Relativity : Reprint 2010, New Delhi
2. W.W.Nortan and Company First Ed (1968)Special Relativity, A P French, MIT,

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Core Course- IV
COURSE TITLE: Special Theory of Relativity
COURSE CODE: 23US6PHCC4STR[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Discipline Specific Elective Course- I

COURSE TITLE: 8085 microprocessor architecture, programming and applications

COURSE CODE: 23US6PHDS1MUP [CREDITS - 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Describe the general architecture of a microcomputer system and architecture and organization of 8085. 2. Understand and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming. 3. Use advanced programming techniques.		
Module 1	**Basic concepts of microprocessor**	**[12L]**
Learning Objectives: The module is intended to 1. Learn the fundamentals of microprocessor.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Identify various components of a microprocessor. 2. List the four operations of microprocessor. 3. Recognize the functions of various pins of the 8085 microprocessor		
1.1	Microprocessors, microprocessor instruction set and computer languages.	[3L]
1.2	Microprocessor architecture and its operations, the 8085 microprocessor, microprocessor communication and bus timings, a detailed look at the 8085 MPU and its architecture, 8085 machine cycles and bus timings	[9L]

Module 2	Introduction to 8085 assembly language programming	[12L]
Learning Objectives: The module is intended to 1. Learn assembly language programs.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Explain various functions of registers. 2. Classify the instructions. 3. Recognize the addressing modes of the instructions. 4. Draw the flowchart and write simple programs.		
2.1	8085 programming model, instruction classification, instruction and data format, addressing modes, simple programs.	[12L]
Module 3	**Programming Techniques**	**[12L]**
Learning Objectives: The module is intended to 1. Learn various programming techniques.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Use the technique of looping. 2. Write instructions for delay time. 3. Use stacks and subroutines		
3.1	Looping, counting and indexing, additional arithmetic and data transfer instructions, arithmetic operations related to memory, logical operation rotate, logical operation compare, counters and delays, stack, subroutine	[12L]

References:

1. Gaonkar R.S. (1989), Microprocessor architecture, programming and applications with 8085,4th edition, Penram International Publishing (India) Pvt.Ltd. .
2. B.Ram (2012), Fundamentals of microprocessors and microcontrollers, Dhanpat Rai Publication
3. Rafiquzzaman M, (2016), Microprocessors, Theory and applications, Pearson publicationRobert Resnick (Wiley Student Edition)

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Discipline Specific Course- IV
COURSE TITLE: 8085 microprocessor architecture, programming and applications
COURSE CODE: 23US6PHDS1MUP[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Discipline Specific Elective Course- II

COURSE TITLE: C programming

COURSE CODE: 23US6PHDS2CPG [CREDITS - 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Identify and abstract the programming task involved for a given computational problem. 2. Approach the programming tasks using techniques learned and write the pseudo-code. 3. Write the C code for a given algorithm. 4. Write the C program on a computer, edit, compile, debug, correct, recompile and run it.		
Module 1	**Introduction to Computers, C Programming**	**[12L]**
Learning Objectives: The module is intended to 1. Learn the fundamental of hardware, software, operating systems, programming, problem solving, and software engineering. 2. Create simple programs with the understanding of basic input, processing, and output structure		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Create simple programs with the understanding of basic input, processing, and output structure.		
1.1	Fundamentals of Computing, Computer Systems: Hardware and Software Programs and Programming Languages, Pseudo-code and flowcharts. Memory, Variables, Values, Instructions, Programs Input, Processing, and Output. The steps in the Programming	[6L]

	Process	
1.2	Getting Started with C, The C Character Set, Constants, Variables and Keywords. The First C Program, Compilation and Execution, Receiving Input, C Instructions, Type Declaration Instruction, Arithmetic Instruction, Integer and Float Conversions.	[6L]
Module 2	**Control structures in programming**	**[12L]**
Learning Objectives: The module is intended to 1. Learn different control structures C programming.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Use If, if-else and switch Loop Control structures for problem solving 2. Use while –do, arrays and strings for programming		
2.1	Control Structures :- Decision making structures, If, if-else, switch Loop Control structures	[4L]
2.2	While, do-while, for Nested structures break and continue, Arrays :- Array Initialisation	[4L]
2.3	Strings as array of characters, string Library functions.	[4L]
Module 3	**Functions and pointers in C programming**	**[12L]**
Learning Objectives: The module is intended to 1. Understand functions in C , it's declaration and uses and also the concept of pointers. Learn various programming techniques.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Use functions and pointers in programming		
3.1	Functions: The prototype declaration, Function definition	[4L]
3.2	Function call: Passing arguments to a function, by value, by reference. Scope of variable names. Recursive function calls, Tail	[4L]

	recursion. Analysing recursion, Tree of recursion, linear recursion.	
3.3	Pointers : Pointer variables. Declaring and dereferencing pointer variables.	[4L]

References:

1. Yashwant Kanetkar (2016) Let us C INDIA : BPB Publications
2. E. Balguruswamy (2019) Programming in ANSI C India Tata Mc-Graw Hill

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Discipline Specific Elective Course- II
COURSE TITLE: C programming
COURSE CODE: 23US6PHDS2CPG [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I		10	10	10	30
II		10	10	10	30
III	10	10	10		30
Total marks per objective	10	30	30	20	90
% Weightage	11 %	34 %	33%	22 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Discipline Specific Elective Course- III

COURSE TITLE: Applied Optics

COURSE CODE: 23US6PHDS3AOP [CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Understand the ray optics 2. Learn about fiber optics. 3. Use LASER for different applications 4. Understand non-linear optics. 5. Use different spectroscopic techniques

Module 1	Light transportation system. Geometrical optics	[12L]
Learning Objectives: The module is intended to 1. Determine the path of light using ray tracing method 2. Design the simple lens system for magnified image. 3. Design optical system to propagate light beam.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Know the working principle of optical fiber. 2. Discuss various application of optical fiber. 3. Select optical sources and detectors to design fiber optics based system. 4. Learning Outcome: after compilation of this module student should able to understand and design various light propagation system and image formation for various applications. 5. Introduction to Integrated Optics.		
1.1	Ray Optics: Various components of geometrical optics: mirrors, lenses, prism, polarizer, wave plate, grating. Image formation using lenses, Combination of lenses, focal and cardinal points of lenses, Working principal of basic optical instruments: microscope, telescope.	[6L]

1.2	Optical fibers :Review of Light transmission through optical fiber, types of optical fiber, Optical sources and detectors used for optical fiber, Losses in optical fiber, application in commutation, Optical fiber as sensors, integrated optics	[6L]
Module 2	**Modern Optics**	**[12L]**

Learning Objectives:
The module is intended to

1. Able to measure/ calculate various parameters of light sources/ laser source.
2. Make selection of proper source based on application.
3. Introduction to nonlinear optics
4. Various techniques of holography
5. Able to design simple system to record hologram

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

1. Able to use LASER as a tool for various applications.

2.1	Laser and its application: Review of working principle of Laser, Laser beam characteristic.	[3L]
2.2	Types of lasers based on active medium, CW and pulsed laser, laser pulse compression techniques, Selection parameters of lasers for various application, laser material processing/interaction,	[3L]
2.3	Applications in industrial, research and medical field, laser safety	[3L]
2.4	Non-linear Optics: Introduction, Photon addition, harmonic generation, frequency mixing (optical parametric oscillator)	[3L]
Module 3	**Optical techniques for material characterization**	**[12L]**

Learning Objectives:
The module is intended to

1. Know spectroscopy techniques and evaluate some basic samples using these techniques.
2. Apply interference and diffraction principles.
3. Compare properties of various optical sources and detectors

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

1. Develop skill to design the spectroscopy system for laboratory application

3.1	Optical techniques for material characterization: Absorption and transmission spectroscopy, UV-VIS-IR spectrometer, measurement of absorption/ transmission for samples Emission spectroscopy.	[8L]
3.2	Opto-electronics: Optical sources: characteristics of optical sources and source selection. Optical sensors: basic principles of semiconductor detectors, thermal detectors, photo diodes, photo transistor photo-multipliers solar cells (PV module), CCD	[4L]

References:

1. Brij Lal, M N Avadhanulu & N Subrahmanyam(2012): A Text Book of Optics, 25/e: S.Chand Publication
2. Ghatak Ajoy (2005): Optics 3/e : Ajoy Ghatak: Tata McGraw-Hill Education
3. Hecht E (2008): Optics 4/e : Pearson Education; 4 edition (2008)
4. Nambiar K. R. (2004) : Lasers: Principles, Types and Applications: New age Publication
5. Nagabhushana S (2010) Lasers and Optical Instrumentation: I. K. International Pvt Ltd
6. Khangaonkar P R (2008) An Introduction to Material Characterization : Penram intl. Publishing

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Discipline Specific Elective Course- III
COURSE TITLE: Applied Optics
COURSE CODE: 23US6PHDS3AOP [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	10	10	5	5	30
II	10	10	5	5	30
III	10	10	5	5	30
Total marks per objective	30	30	15	15	90
% Weightage	34 %	34 %	11 %	11 %	100

T.Y. B. Sc. (Physics) SEMESTER VI

Skill Enhancement Course- I

COURSE TITLE: Electrical circuits and Networkskills

COURSE CODE: 23US6PHSE2ECN [CREDITS - 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Analyse electrical components 2. Design and analyze the networks and appliances 3. Monitor the devices with their specific properties. 4. Protection of the electrical components and circuit		
Module 1	**Introduction to Basic Electricity Principles**	**[12L]**
Learning Objectives: The module is intended to 1. Outline and brief description, including fundamentals, of the different type of circuits and respective networks; 2. Overview of electrical circuits and applications		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Analyse electrical components 2. Design and analyze the networks and appliances		
1.1	Basic Principles : Ohm`s law, Series and Parallel circuit, Potential, Ideal and practical voltage and current source, Basic concepts of L and C, Series and parallel combination of R, L and C. Problems based on Star and Delta circuit. Rules to analyze DC source electrical circuits, Symbols used in electrical circuits (Review: DC transients of LR, CR and LCR) Problems based LR, CR, LCR circuit	[5L]
1.2	AC fundamentals :Fundamentals of AC, Phasor analysis, (Review: AC through R, L, C, LR, CR, LCR, power in AC circuits), Problems	[4L]

	based on AC analysis for electrical components	
1.3	Introduction to electrical devices :Basics of Transformer, Ideal and Practical Current and Voltage Source, Familiarization with Multimeter (Case study: PMMC), voltmeter and ammeter, Problems	[3L]
Module 2	**Application and Protection of Electrical Circuits**	**[12L]**

Learning Objectives:
The module is intended to

1. Describe the electrical appliances with AC or DC sources;
2. Describe active and passive components of electrical circuits

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

1. Monitor the devices with their specific properties.
2. Learn the protection of the electrical components and circuits

2.1	Generators :Principle, construction and working of single-phase and three-phase AC and DC generators, Problems based Star and Delta connections	[5L]
2.2	Electric Motors: Three-phase AC and DC motors. Basic design. Interfacing DC and AC sources to control heater & motors. Speed and power of AC and DC motor (series and shunt)	[5L]
2.3	Electrical Protection: Overload devices: Relays, Fuses, Disconnect switches, Circuit breakers. Ground-fault protection. Grounding and isolation	[2L]

References:

1. B.L. Theraja A text book in electrical technology– S Chand & Co.
2. A.K. Theraja.A text book of electrical technology – S Chnd & Co

Question Paper Template
T.Y. B. Sc. (Physics) SEMESTER VI
Skill Enhancement Course- I

COURSE TITLE: Electrical circuits and Network skills

COURSE CODE: 23US6PHSE1ECN [CREDITS - 01]

Module	Remembering/ Knowledge	Understanding	Applying	ANALYSING /EVALUATING /CREATING	Total marks
I	15	15	10	5	45
II	15	15	10	5	45
Total marks per objective	30	30	20	10	90
% Weightage	34 %	33 %	22 %	11 %	100

SEMESTER VI

Practical Core Course

COURSE CODE: 23US6PHP1 & 23US6PHP2

Course Learning Outcomes:

1. Understanding relevant concepts.
2. Planning of the experiments.
3. Layout and adjustments of the equipment.
4. Recording of observations and plotting of graphs.
5. Calculation of results and estimation of possible errors in the observation of results.

Regular Physics Experiments: A minimum of 8 experiments from each of the course are to be performed and reported in the journal.

Demonstration: Minimum 7 demonstration experiments are compulsory and must be reported in the Journal. Skills will be tested during the examination through viva or Practical.

The certified journal must contain a minimum of 16 regular experiments (8 from each group) , 6 experiments from DSE (any two DSE branch, 3 from each group) and 7 demonstration experiments in semester V.

A separate index and certificate in journal are must for each semester course.

There will be three turns of three hours each for the examination of practical course

COURSE CODE: 23US6PHP1	
1	Quincke"s method for surface tension of Mercury
2	Flat spiral spring (η)
3	R.P. of prism
4	Lloyd"s mirror
5	Double refraction
6	FET characteristics

7	UJT characteristics
8	SCR characteristics
9	Photodiode and phototransistor characteristics
10	JFET as switch (series and shunt)
11	Solar cell characteristics and determination of Voc, Isc and Pmax
12	Michelson's interferometer
COURSE CODE: 23US6PHP2	
1	M/C using B.G.
2	Capacitance by using series bridge
3	Transistorized Astable MV
4	TransistorizedMonostable MV
5	Schmitt Trigger using OPAMP
6	IC 555 as astable MV
7	IC 555 as monostable MV
8	IC 555 as ramp generator
9	Counters: mod 2,mod 5 and mod 10
10	Op amp as monostable/astable MV
11	Triangular and square waveform generator
12	Op amp as instrumentation amplifier
Demonstration Experiments	
1	Open CRO, Power Supply, and Signal Generator: Discuss block diagram.
2	Data sheet reading for diodes, Transistor, Op amp and Optoelectronic devices.
3	Circuit designing – single stage amplifier, Transistor Multivibrator etc. and testing on breadboard.
4	Equation Solver
5	Amplitude Modulation
6	Frequency Modulation
7	Millikan"s oil drop experiment.
8	Zeeman Effect.

9	Iodine absorption spectra.
10	Standing waves in liquid using Ultrasonic waves.
11	PC simulation of 8085
12	Use of PC / µP to control real world parameters.
13	Seven segment display
14	GM counter

References:

1. D. Chattopadhya, PC. Rakshit & B. Saha: Advanced course in Practical Physics :
2. Harnam Singh : BSc Practical Physics: (2001)S. Chand & Co. Ltd.
3. Samir Kumar Ghosh A Text book of Practical Physics: New Central Book Agency (4rd edition).
4. C. L. Arora B Sc. Practical Physics : (1st Edition)(2001) S. Chand & Co. Ltd.
5. C. L. Squires Practical Physics:– (3rd Edition) Cambridge University Press.
6. D C Tayal University Practical Physics : Himalaya Publication.

SEMESTER VI

Practical Discipline Specific Elective Course

COURSE CODE: 23US6PHDSP

DSE1	
1	Write a program using 8085 Microprocessor for Hexadecimal addition and subtraction of two Numbers.
2	Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3	To perform multiplication of two 8 bit numbers using 8085.
4	To perform division of two 8 bit numbers using 8085.
5	To find the largest / smallest number in an array of data using 8085 instruction set.
6	To write a program to arrange an array of data in ascending and descending order.
7	To write a program to sort the odd/even numbers.
8	To write a program to sort positive/negative numbers.
9	To write a program to transfer a block of data from one memory location to another.
10	To write a program to add series of numbers.
DSE2	
1	Programs based on arithmetic expression,
2	Program based on fixed mode arithmetic.
3	Programs based on conditional statements
4	Programs based on control structures
5	Programs based on arrays (1-D, 2-D),
6	Programs based on functions
7	Programs based on pointers.

DSE3	
1	Design and study two lens system.
2	Study V-I characteristics of several LEDs / Laser Diode.
3	Compare diverengence of RED diode and HE-Ne laser
4	Study of optical fiber transmission characteristics.
5	Laser application as Bar code reader.
6	Study of absorption spectrum.

References:

1. RPJ: R. P. Jain Modern Digital Electronics, 3rd Edition, Tata McGraw Hill.
2. RG: Ramesh Gaonkar: Microprocessor Architecture, programming and Applications with the 8085, 5th Edition, Prentice Hall of India.
3. Vibhute and Borole : Microprocessor and Applications, Techmax Publications, Pune.
4. Gilmore: Microprocessor, Principles & Applications (2nd Ed) TMH
5. Yashwant Kanetkar (2016) Let us C INDIA : BPB Publication