BON SECOURS COLLEGE FOR WOMEN (AUTONOMOUS)

Accredited with A++ Grade by NAAC in Cycle II

Affiliated to Bharathidasan University, Tiruchirappalli

UGC Recognized 2(f) and 12(B) Institution

VILAR BYPASS, THANJAVUR - 613 006, TAMIL NADU

DEPARTMENT OF PHYSICS

Programme: B.Sc Physics

SYLLABUS

SEMESTER – I

CORE COURSE-I
PROPERTIES OF MATTER AND ACOUSTICS

COURSE CODE: 24UPS401
CONTACT HOURS/WEEK: 05 **CREDIT: 04**

INTERNAL MARK: 25 **EXTERNAL MARK: 75**

COURSE OUTCOME:

Unit	CO.NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	CO1	Relate elastic behavior in terms of three modulii of elasticity and working of torsion pendulum.	K1-K5
II	CO2	Able to appreciate concept of bending of beams and analyze the expression, quantify and understand nature of materials.	K1-K5
III	CO3	Explain the surface tension and viscosity of fluid and support the interesting phenomena associated with liquid surface, soap films provide an analogue solution to many engineering problems.	K1-K5
IV	CO4	Analyze simple harmonic motions mathematically and apply them. Understand the concept of resonance and use it to evaluate the frequency of vibration. Set up experiment to evaluate frequency of ac mains	K1-K5
V	CO5	Understand the concept of acoustics, importance of constructing buildings with good acoustics. Able to apply their knowledge of ultrasonic's in real life, especially in medical field and assimilate different methods of production of ultrasonic waves	K1-K5

K1-Remember; K2-Understand; K3-Apply; K4- Analyze; K5-Evaluate; K6-Create

SYLLABUS

UNIT-I ELASTICITY:

Hooke's law – stress-strain diagram – elastic constants –Poisson's ratio – relation between elastic constants and Poisson's ratio – work done in stretching and twisting a wire – twisting couple on a cylinder – rigidity modulus by static torsion– torsional pendulum (with and without masses)

UNIT-II BENDING OF BEAMS:

Bending of beams – expression for Bending moment – cantilever -expression for depression at the loaded end of the cantilever– oscillations of a cantilever – expression for time period – experiment to find Young's modulus – non-uniform bending– experiment to determine Young's modulus by Koenig's method – uniform bending – expression for elevation – experiment to determine Young's modulus using microscope

UNIT-III FLUID DYNAMICS:

Surface tension: Molecular forces– Surface energy - Angle of contact- excess of pressure over curved surface – application to spherical and cylindrical drops and bubbles – Experimental determination of surface tension by Drop- weight method- determination of surface tension by Jaegar's method–variation of surface tension with temperature

Viscosity: Streamline and turbulent flow – rate of flow of liquid in a capillary tube – Poiseuille's formula – corrections – Experimental determination of co-efficient of a liquid by Poiseuille's method- terminal velocity and Stoke's formula – Lubrication – Equation of continuity of flow - Bernoulli's theorem - variation of viscosity with temperature and Pressure

UNIT-IV WAVES AND OSCILLATIONS:

Simple Harmonic Motion (SHM) – differential equation of SHM – graphical representation of SHM – composition of two SHM in a straight line and at right angles – Lissajous's figures- free, damped, forced vibrations –resonance and Sharpness of resonance. Laws of transverse vibration in strings – sonometer – determination of AC frequency using sonometer–determination of frequency using Melde's string apparatus

UNIT-V ACOUSTICS OF BUILDINGS AND ULTRASONICS:

Intensity of sound – decibel – loudness of sound –reverberation – Sabine's reverberation formula – acoustic intensity – factors affecting the acoustics of buildings. **Ultrasonic waves:** production of ultrasonic waves – Piezoelectric crystal method –magnetostriction effect – application of ultrasonic waves

TEXT BOOKS

1. D.S.Mathur, 2010, Elements of Properties of Matter, S.Chand and Co.
2. BrijLaland N. Subrahmanyam, 2003, Properties of Matter, S.Chand and Co
3. D.R.Khanna andR.S.Bedi, 1969, Textbook of Sound, AtmaRamand sons
4. BrijLal and N.Subrahmanyam, 1995, A Text Book of Sound, Second revised edition,Vikas Publishing House.
5. R.Murugesan,2012, Properties of Matter, S.Chandand Co.

REFERENCEBOOKS

1. C.J. Smith, 1960, General Properties of Matter, Orient Longman Publishers
2. H.R. Gulati, 1977, Fundamental of General Properties of Matter, Fifth edition,R. Chand and Co.
3. A.P French, 1973, Vibration and Waves, MIT Introductory Physics, Arnold-Heinmann India.

WEB RESOURCES

1. https://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work
2. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.html
3. https://www.youtube.com/watch?v=gT8Nth9NWPM
4. https://www.youtube.com/watch?v=m4u-SuaSu1sandt=3s
5. https://learningtechnologyofficial.com/category/fluid-mechanics-lab/
6. http://www.sound-physics.com/
7. http://nptel.ac.in/courses/112104026/

CORE COURSE-II

HEAT, HERMODYNAMICS AND STATISTICAL PHYSICS

COURSE CODE:24UPH501

CONTACT HOURS / WEEK: 04 **CREDIT: 4**

INTERNAL MARK: 25 **EXTERNAL MARK: 75**

COURSE OUTCOMES:

UNIT	CO.No.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	**CO1**	Understand the fundamental concepts of thermodynamic systems, including energy, work, heat, and their interrelationships.	K1-K5
II	**CO2**	Gain a comprehensive understanding of the fundamental principles underlying radiative heat transfer. Students will be able to analyze and apply the concept of specific heat in thermodynamics to solve problems related to heat transfer	K1-K5
III	**CO3**	Explore the understanding of specific heat capacity, gaining insight into the evolution of thermodynamic principles.	K1-K5
IV	**CO4**	In-depth exploration of the liquefaction process for specific gases and Practical application in industry	K1-K5
V	**CO5**	Interpret classical statistics concepts such as phase space, ensemble, Maxwell-Boltzmann distribution law. Develop the statistical interpretation of Bose-Einstein and Fermi-Dirac, Apply to quantum particles such as photon and electron	K1-K5

K1-Remember; K2-Understand; K3-Apply; K4- Analyze; K5-Evaluate; K6-Create

SYLLABUS

Unit I: Quantum Theory- Laws of Thermodynamics

Thermodynamics Zeroth law of thermodynamics – First law of thermodynamics – Heat engines – Reversible and irreversible process of Carnot's theorem – Second law of thermodynamics, Thermodynamic scale of temperature – Entropy: Change of entropy in adiabatic process, reversible and irreversible processes – Temperature – entropy diagram (T.S) – Law of increase of entropy – Maxwell thermo dynamical relations – Clausius-Claypeyron's latent heat equations.

Unit II: Heat Transfer:

Conduction: Coefficient of thermal conductivity –Rectilinear Flow of Heat along a Bar – Thermal conductivity of good conductors: Forbe's method – Thermal conductivity of a bad conductor: Lee's disc method- Heat flow through a Compound Wall – Wiedemann – Franzlaw-Practical Applications of Conduction of Heat.

Radiation: Stefan's law, Deduction of Newton's law from Stefan's law – Boltzmann law – Black body radiation (Ferry's method)– Wein's law – Rayleigh- Jean's law – Planck's law – Angstrom Pyroheliometer – Solar constant – Surface temperature of sun Sources of solar energy –Some everyday applications.

Unit III: Specific Heat Capacity

Specific heat capacity of solids- Regnault's specific heat capacity of solids – Regnault's method of

mixtures- Radiation correction Dulong and Petit's law- Einstein's theory- Specific heat of liquids- Newton's law of cooling- Specific heat of gases- Mayer's Relation- Quantization of various contributions to energy of diatomic molecules- Specific heat of diatomic gases.

Unit IV: Low Temperature Physics: Joule- Kelvin effect- Temperature of inversion- Porous plug experiment- Joule-Thomson effect- Boyletemperature- Liquefaction of gases- Principle of regenerative cooling- Linde's process- Liquefaction of Hydrogen- Adiabatic demagnetization- Liquefaction of Helium- Practical Applications of Low Temperature- Refrigerating mechanism- Air conditioning mechanism- Solid Carbon dioxide (Dry Ice)

Unit V: STATISTICAL PHYSICS: Definition of phase-space – micro and macro states – ensembles –different types of ensembles – classical and quantum Statistics – Maxwell-Boltzmann statistics – expression for distribution function – Bose-Einstein statistics – expression for distribution function – Fermi-Dirac statistics –expression for distribution function – comparison of three statistics

TEXT BOOKS:

1. Brijlal, Subrahmanyam and Hemne, "Heat Thermodynamics and Statistical Physics" S. Chand& Co. (2007)
2. J.B.Rajam and C.L Arora, "Heat and Thermodynamics". S. Chand Limited, 1999
3. Brijlal and N. Subramaniam, 2000, Heat and Thermodynamics, S. Chand and Co.
4. Narayanamoorthy and Krishna Rao, 1969, Heat, Triveni Publishers, Chennai.
5. Brijlal and N. Subramanyam, 2001, Waves and Oscillations, Vikas Publishing House, New Delhi.
6. R.Murugeshan and Kiruthiga Sivaprasath, Thermal Physics, S. Chand and Co.

REFERENCE BOOKS

1. J.B.Rajamand C.L.Arora, 1976, Heat and Thermodynamics, 8th edition, S. Chand and Co. Ltd.
2. D.S.Mathur, Heat and Thermodynamics, Sultan Chand and Sons.
3. Mark W.Zemansky, "Heat and Thermodynamics" 7th Edition, Mc Graw Hill Higher education, 1997.
4. Gupta, Kumar, Sharma, 2013, Statistical Mechanics, 26th Edition, S. Chand and Co.
5. Resnick, HallidayandWalker,2010, Fundamentals of Physics, 6th Edition.
6. Sharma and Sarkar K.K " Thermodynamics and Statistical Physics", Himalaya Publishing House, 2nd, 2018

WEB RESOURCES

1. https://youtu.be/M_5KYncYNyc
2. https://www.youtube.com/watch?v=4M72kQulGKkandvl=en
3. http://www.freebookcentre.net/Physics/Physics-Books-Online.html
4. https://openstax.org/books/physics/pages/11-2-heat-specific-heat-and-heat-transfer
5. Lecture 1: Thermodynamics Part 1 | Video Lectures | Statistical Mechanics I: Statistical Mechanics of Particles | Physics | MIT OpenCourseWare

CORE LABORATORY- I
GENERAL PHYSICS LAB-I

COURSE CODE: 24UPH551
CONTACT HOURS/WEEK:4 **CREDIT: 2**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO. No.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Understand fundamental concepts such as density, volume and mass.	**K2**
CO2	Learn experimental techniques for measuring properties like density, viscosity and surface tension.	**K3**
CO3	Acquire the experimental skill of verifying laws in Physics.	**K3**
CO4	Acquire the experimental skill of verifying laws in Physics.	**K3**
CO5	Analyze and interpret experimental data to draw conclusions about the behavior of matter.	**K4**

K2-Understand; K3-Apply; K4- Analyze;

EXPERIMENTS: (ANY 10)

1. Measurement of length (or diameter) using vernier calipers, screw gauge and travelling microscope.
2. Determination of Young's modulus-Non-uniform bending – Pin & Microscope method.
3. Determination of Young's modulus - Cantilever depression – Scale and Telescope method
4. Surface Tension, Interfacial surface tension- Drop weight method.
5. Surface Tension by Capillary Rise Method.
6. Compound Pendulum – Determination of g & k .
7. Coefficient of viscosity of liquid – Poiseuille's flow method.
8. Comparison of viscosities of two liquids -Ostwald's viscometer/ Hare's Apparatus.
9. Determination of the Elastic constant of a wire by Searle's method.
10. Torsional pendulum – Determination of n & I.
11. Absolute determination of M and H using deflection and vibration Magnetometer.
12. Spectrometer – Determination of refractive index of a solid prism.
13. Determination of frequency of a tuning fork using Melde's string apparatus.
14. Verification of laws of vibration of a stretched string and determination of the frequency of a tuning fork-Sonometer.
15. The viscosity of highly viscous liquid – Stokes method.
16. Determination of Young's modulus- Uniform bending – Pin & Microscope method.

REFERENCES:

1. Department of Physics, Practical Physics, (B.Sc. Physics Main), St. Joseph's College, Tiruchirappalli, 2009.
2. Dr. S. Somasundaram, Practical Physics, Apsara Publications, Tiruchirappalli, 2012.
3. M.N. Srinivasan, Textbook of Practical Physics, Sultan Chand & Sons, 1990
4. V. VIjayendran, Practical Physics and Electronics, S. Vishwanathan Printers & Publishers Pvt Ltd, 2009

SEMESTER -II
CORE COURSE-III
MECHANICS AND RELATIVITY

COURSE CODE: 24UPH502
CONTACT HOURS/WEEK: 05 **CREDIT: 04**
INTERNAL MARK: 25 **EXTERNAL MARK: 75**

COURSE OUTCOMES:

UNIT	CO. NO.	UPON COMPLETION OF THIS COURSE, THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	CO-1	Describe Newton's Law of motion; general theory of relativity; Kepler's laws and realize the basic principles behind planetary motion.	K1-K4
II	CO-2	Understand the concepts of the conservation laws & angular momentum.	K1-K4
III	CO-3	Apply conservation laws and calculate the energy of various systems differentiate conservative and non-conservative forces.	K1-K4
IV	CO-4	Calculate the kinetic energy of rotation for rigid bodies, identify and describe real-world applications of gyroscopic principles in technology.	K1-K4
V	CO-5	Analyze the concepts of both classical and Einstein's relativity	K1-K4

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

SYLLABUS

UNIT I: Laws of Motion

Newton's Laws – forces – Equations of motion – Frictional force – Motion of a particle in a uniform gravitational field – Types of everyday forces in Physics. Gravitation: Classical theory of gravitation–Kepler's laws, Newton's law of gravitation – Determination of G by Boy's method – Earth-moon system – Weightlessness – earth satellites – Parking orbit – Earth density – mass of the Sun – Gravitational potential – Velocity of escape – Satellite potential and Kinetic energy –Einstein's Theory of Gravitation.

UNIT II: Conservation Laws of Linear and Angular Momentum

Conservation of linear and angular momentum – Internal forces and Momentum conservation – center of mass – examples – general elastic collision of particles of different masses – system with variable mass – examples – conservation of angular momentum – torque due to internal forces – torque due to gravity – angular momentum about the center of mass – proton scattering by heavy nucleus.

UNIT III: Conservation Laws of Energy

Introduction – significance of conservation laws – law of conservation of energy concepts of work- power – energy – conservative forces – potential energy and conservation of energy in gravitational and electric field – examples – non-conservative forces – general law of conservation of energy.

UNIT IV: Rigid Body Dynamics

Translational and Rotational motion – Angular Momentum – Moment of inertia – General theorems of Moment of Inertia – examples – Rotation about fixed axis – Kinetic Energy of Rotation – examples – Body rolling along a plane surface – body rolling down an inclined plane – gyroscopic precision – gyrostatic applications.

UNIT V: Theory of Relativity

Galilean – Newtonian relativity - Galilean transformations – Michelson Morley experiment and its importance –Basic ideas of the general theory of relativity - Lorentz transformations and its interpretation – consequence of Lorentz transformation – Length contraction, time dilation – relativistic addition of velocities – Mass energy equivalence.

Text Books:

1. Mathur. D.S, (2000), *Mechanics*, 12th Edition, S.Chand & Company Ltd., New Delhi.
2. Durai Pandian . P, Laxmi Durai Pandian, Muthamizh Jayapragasam, (2007) *Mechanics,* 6th revised Edition, S.Chand and Co.
3. Narayanamurthi, M.and Nagarathnam. N, (1998) *Dynamics.* The National Publishing, Chennai.
4. Narayanamurthi, M. and Nagarathnam, N, (1982) *Statics, Hydrostatics and Hydrodynamics,* The National Publishers, Chennai.
5. Upadhaya, J.C. (2019) Classical Mechanics, Himalaya Publishing House, Mumbai.
6. Murugesan. R. and Kiruthiga Sivaprasath, (2017) *Modern physics*, 18th Revised Edition, S.Chand & Company Ltd., New Delhi.

Reference Books

1. Goldstein Herbert, (2011) *Classical Mechanics*. U.S.A: Addison and Wesely.
2. Halliday, David and Robert, Resnick, (1995) *Physics Vol. I.* New Age, International, Chennai.
3. Halliday, David Robert Resnick and Walker Jearl, (2001), *Fundamentals of Physics,* John Wiley, New Delhi
4. Venkataraman, M K, (2011) *Dynamics,* Trichy: Agasthiar Book Deport.

Web Resources

1. https://nptel.ac.in/courses/115103115
2. https://www.youtube.com/watch?v=p075LPq3Eas
3. https://www.youtube.com/watch?v=mH_pS6fruy
4. https://onlinecourses.nptel.ac.in/noc22_me96/preview
5. https://www.youtube.com/watch?v=tdkFc88Fw-M
6. https://onlinecourses.nptel.ac.in/noc21_me70/preview
7. https://www.mooc-list.com/tags/gravitation
8. https://archive.org/details/NPTEL-Physics
9. https://www.academia.edu/8233163/Basics_of_Mechanics_notes_

CORE LAB II

GENERAL PHYSICS LAB II

COURSE CODE: 24UPH552

CONTACT HOURS/WEEK:4 **CREDIT: 2**

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COURSE OUTCOMES:

CO. No.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Comprehend fundamental principles of thermodynamics, electromagnetism, optics, and acoustics through practical experiments.	K2
CO2	Acquire the skill of handling instruments.	K3
CO3	Acquire the experimental skill of verifying laws in Physics.	K3
CO4	Apply theoretical concepts to experimental situations, fostering critical thinking and problem-solving skills.	K3
CO5	Analyze and interpret experimental data to draw conclusions about the behavior of matter.	K4

EXPERIMENTS:

1. Determination of Specific heat capacity of a liquid – Newtons law of cooling.
2. The emissive power of a surface – Spherical Calorimeter.
3. Joules Calorimeter – Specific heat capacity of a liquid.
4. Potentiometer – Temperature co-efficient of a thermistors.
5. Spectrometer – Determination of angle of prism.
6. Spectrometer – Dispersive power of prism.
7. Thermal conductivity of a bad conductor – Lees disc method.
8. The figure of merit of a mirror galvanometer-Ballistic Galvanometer
9. Carey Foster bridge – Determination of specific resistance of the given coil
10. Meter bridge – Determination of specific resistance of the given coil
11. Velocity of sound through a wire using Sonometer.
12. Determination of velocity of sound using Kunds tube.
13. Determination of frequency of an electrically maintained tuning fork
14. Verify the laws of transverse vibration using sonometer.
15. Verify the laws of transverse vibration using Melde's apparatus.
16. Compare the mass per unit length of two strings using Melde's apparatus.
17. Determination of Thermal conductivity of a good conductor – Searle's method.
18. Determination of Specific Heat Capacity of Solid-Joule's Calorimeter

REFERENCES:

1. M.N. Srinivasan, (2013), *Practical Physics*, S.Chand & Company Ltd., New Delhi.
2. Department of Physics, Practical Physics, (B.Sc. Physics Main), St. Joseph's College, Tiruchirappalli, 2009.
3. Dr. S. Somasundaram, Practical Physics, Apsara Publications, Tiruchirappalli, 2012.

SEMESTER -III

CORE COURSE - IV

OPTICS AND LASER PHYSICS

COURSE CODE: 24UPS402
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARK: 25 **EXTERNAL MARK: 75**

COURSE OUTCOMES:

Unit	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	**CO1**	Understand and analyze various optical aberrations in lenses and learn methods to minimize them for better image formation.	**K1-K4**
II	**CO2**	Discuss the principle of superposition of wave, use these ideas to understand the wave nature of light through working of interferometer	**K1-K4**
III	**CO3**	Extend the knowledge about nature of light through diffraction techniques; apply mathematical principles to analyze the optical instruments	**K1-K4**
IV	**CO4**	Interpret basic formulation of polarization and gain knowledge about polarimeter, appraise its usage in industries	**K1-K4**
V	**CO5**	Relate the principles of optics to various fields of IR, Raman and UV spectroscopy and understand their instrumentation and application in industries	**K1-K4**

SYLLABUS

UNIT-I Lens: aberrations: spherical aberration, chromatic aberrations, coma, and astigmatism– curvature of the field – distortion – chromatic aberrations methods.

Eyepieces: advantage of an eyepiece over a simple lens – Huygen's and Ramsden's eyepieces, construction and working –merits and demerits of the eyepiece.

Resolving power: Rayleigh's criterion for resolution – limit of resolution for the eye – resolving power of, (i) Prism (ii) grating (iii) telescope

UNIT-II INTERFERENCE: Air wedge – Newton's rings – Haidinger's fringes – Brewster's fringes – Michelson Interferometer and its applications – Fabry- Perot Interferometer – Interference filter – Stationary waves in light – Colour photography (qualitatively)

UNIT-III DIFFRACTION: Fresnel's assumptions – zone plate – action of zone plate for an incident spherical wave front – differences between a zone plate and a convex lens –Fresnel type of diffraction – diffraction pattern due to a straight edge – positions of maximum and minimum intensities – diffraction due to a narrow slit –Fraunhofer type of diffraction – Fraunhofer diffraction

at a single slit – plane diffraction grating– experiment to determine wavelengths – width of principal maxima.

UNIT-IV POLARISATION: Optical activity – optically active crystals –polarizer and analyser– double refraction – Huygens's explanation of double refraction in uniaxial crystals –polaroids and applications – circularly and elliptically polarized light –quarter wave plate – half wave plate – production and detection of circularly and elliptically polarized lights – Fresnel's explanation – specific rotation – Laurent half shade polarimeter.

UNIT-V LASERS: General principles of lasers – properties of lasers action – spontaneous and stimulated emission – population inversion – optical pumping – He-Ne laser (principle and working) –Ruby laser (principle and working)– laser applications – holography- Construction and reconstruction of a hologram – Applications.

TEXT BOOKS

1. N. Subrahmanyam and Brij Lal. (2014). *Optics* (25th ed.). S. Chand & Company, New Delhi.
2. K. Sivaprasath and R. Murugeshan. (2014). *Optics and Spectroscopy* (5th ed.). S. Chand & Company, New Delhi.
3. V. Rajendran. (2012). *Engineering Physics*. Tata McGraw-Hill, New Delhi

CORE COURSE V
SOLID STATE PHYSICS

COURSE CODE: 24UPH503
CONTACT HOURS/WEEK:4 **CREDIT: 4**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	**CO1**	Identify and explain various types of bonding and their influence on material properties.	**K1-K4**
II	**CO2**	Analyze crystal structures using lattice vectors, unit cells, Miller indices, and Bravais lattices.	**K1-K4**
III	**CO3**	Understand and compare classical and quantum theories of electron behavior in solids.	**K1-K4**
IV	**CO4**	Explain dielectric behavior, polarization mechanisms, and related physical models.	**K1-K4**
V	**CO5**	Describe the fundamental phenomena of superconductivity, including experimental characteristics and theoretical models.	**K1-K4**

Syllabus

Unit I

BONDING IN SOLIDS, CRYSTAL STRUCTURE:

Types of bonding –ionic bonding –covalent bonding – metallic bonding – hydrogen bonding – Van-der-Waals bonding – crystal lattice – lattice translational vectors – lattice with basis – unit cell – Bravais' lattices – Miller indices – Packing fraction –packing of SC, BCC, FCC and HCP structures – structures of NaCl and diamond crystals.

Unit II

ELECTRON THEORY OF METALS AND SEMICONDUCTORS:

Classical free electron theory of metals-Electrical and Thermal conductivity-Widemann Franz law-Quantum free electron theory-Fermi energy-density of states-Band theory of solids-Brillouin zones-semiconductors-carrier concentration of intrinsic-electrical conductivity-carrier concentration of P-type and n-type-Hall Effect-experimental determination of carrier concentration and mobility-application.

Unit III

MAGNETIC PROPERTIES OF SOLIDS:

Permeability, susceptibility, relation between them– classification of magnetic materials – properties of dia, para, ferro, ferri and antiferromagnetism –Langevin's theory of diamagnetism – Langevin'stheory of paramagnetism – Curie-Weiss law – Weiss theory of ferromagnetism(qualitative only) – Heisenberg's quantum theory of ferromagnetism – domains – discussion of B-H curve – hysteresis and energy loss – soft and hard magnets

Unit IV

DIELECTRIC PROPERTIES OF MATERIALS:

Polarization and electric susceptibility – local electric field of an atom – dielectric constant and polarisability – polarization: electronic polarization– calculation of polarisability – ionic, orientational and space charge polarization –Clausius-Mosotti relation –frequency dependence of dielectric constant –dielectric loss – effect of temperature on dielectric constant - dielectric breakdown and its types

Unit V SUPERCONDUCTIVITY

Introduction – Historical developments – General properties of superconductivity - Critical field and Critical temperature – Meissner effect — Type I and Type II superconductors – London equations - penetration depth - Isotope effect– BCS theory – Applications of superconductors.

TEXT BOOKS

1. S.O. Pillai, (2022). *Solid State Physics* (10th ed.). New Age International Pvt. Ltd.
2. N.W. Ashcroft., & N.D. Mermin, (2021). *Solid State Physics*. Holt-Saunders (Indian Edition).

REFERENCE BOOKS

1. C. Kittel, (2003). *Introduction to Solid State Physics*. Wiley Eastern Ltd.
2. A.J. Dekker, (2008). *Solid State Physics*. Macmillan India Ltd., New Delhi.

WEB RESOURCES

1. NPTEL :: Physics - NOC:Solid state physics
2. NPTEL : NOC:Solid State Physics (2021) (Physics)

CORE PRACTICAL III
MODERN OPTICS LAB

COURSE CODE: 24UPH553
CONTACT HOURS/WEEK:4 **CREDIT: 2**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO. No.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Understand and apply core concepts in geometric and wave optics.	K3
CO2	Use lasers, interferometers, spectrometers, and optical detectors effectively.	K3
CO3	Analyze interference, diffraction, polarization, and laser beam properties.	K4
CO4	Design and carry out optical experiments with precision and accuracy.	K6
CO5	Interpret and communicate experimental results through professional lab reports.	K4

LIST OF EXPERIMENTS:

1. Determination of Focal Length of a Convex Lens.
2. Determination of Focal Length of a Concave Lens.
3. Determination of refractive index of prism using spectrometer.
4. Determination of refractive index of liquid using hollow prism and spectrometer.
5. Determination of dispersive power of a prism.
6. Determination of radius of curvature of lens by forming Newton's rings.
7. Determination of thickness of a wire using air wedge.
8. Determination of Cauchy's Constants.
9. Determination of resolving power of grating.
10. Determination of resolving power of telescope.
11. Comparison of intensities using Lummer Brodhum Photometer.
12. Determination of range of motion using Searles goniometer.
13. Verification of Newton's formula for a lens separated by a distance.
14. Determination of refractive index of a given liquid by forming liquid lens.
15. Determination of refractive index using Laser.
16. Determination of wavelengths, particle size using He-Ne Laser
17. Determination of resolving power of Diffraction grating using Laser.
18. Spectrometer – Grating – Minimum deviation position.
19. Polarizability of liquids by finding the refractive indices at different wavelengths.

TEXT BOOKS

1. Department of Physics, St. Joseph's College, Tiruchirappalli. (2009). *Practical Physics (B.Sc. Physics Main)*.
2. S. Srinivasan, (2005). *A Textbook of Practical Physics*. S. Chand Publications.

REFERENCES:

1. R. Sasikumar, (2011). *Practical Physics*. PHI Learning Pvt. Ltd., New Delhi.
2. Department of Physics, St. Joseph's College, Trichy. (2009). *Practical Physics (B.Sc. Physics Main)*.
3. S. Somasundaram, (2012). *Practical Physics*. Apsara Publications, Tiruchirappalli.

SEMESTER -IV
CORE COURSE VI
ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM

COURSE CODE: 24UPH504

CONTACT HOURS/WEEK: 04 **CREDIT: 04**

INTERNAL MARK: 25 **EXTERNAL MARK: 75**

COURSE OUTCOMES:

Unit No.	CO No.	Upon completion of this course the students will be able to	Cognitive Level
Unit 1	CO-1	Understand the principles of capacitors and thermoelectric effects, and apply them in experimental and theoretical contexts.	K1–K4
Unit 2	CO-2	Analyze magnetic effects of current and use laws like Biot-Savart and Ampere's law to solve related physical problems.	K1–K4
Unit 3	CO-3	Explain magnetization and electromagnetic induction, and determine inductance and coupling in various configurations.	K1–K4
Unit 4	CO-4	Understand the behavior of transient and AC circuits, and evaluate their characteristics using concepts like Q-factor and resonance.	K1–K4
Unit 5	CO-5	Apply Maxwell's equations to electromagnetic wave propagation and analyze wave behavior in different media.	K1–K4

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

SYLLABUS

UNIT-I ELECTROSTATICS AND THERMO ELECTRICITY

Coulomb's Law – Gauss's Law and its applications (Electric Field due to a uniformly charged sphere, hollow cylinder & solid cylinder)– Electric Potential – Potential at a point due to a uniformly charged conducting sphere – Principle of a capacitor– Capacity of a spherical and cylindrical capacitors – Energy stored in a charged capacitor–Loss of energy on sharing of charges between two capacitors.

Seebeck effect – Peltier effect – Thomson effect- Thermo emf-laws of thermo emf-thermoelectric power.

UNIT-II MAGNETISM AND ELECTROMAGNETIC INDUCTION:

Magnetic induction B – magnetization M - relation between B, H and M – magnetic susceptibility – magnetic permeability – experiment to draw B-H curve – energy loss due to hysteresis - Importance of hysteresis curves

Faraday and Lenz laws –vector form – self-induction – coefficient of self-inductance

of solenoid – Anderson's method – mutual induction – coefficient of mutual inductance between two coaxial solenoids – coefficient of coupling - –Experimental determination of self (Rayleigh's method) and mutual inductance– earth inductor- determination of angle of dip(Φ)

UNIT: III MAGNETIC EFFECTS OF CURRENT:

Biot and Savart's law – magnetic induction due to circular coil – magnetic induction due to solenoid – Helmholtz tangent galvanometer –force on a current element by magnetic field – force between two infinitely long conductors – torque on a current loop in a field - moving coil galvanometer – damping correction- Kirchhoff's Laws of Electricity – Wheatstone's bridge – Carey Foster's Bridge–Potentiometer– Calibration of Ammeter – Calibration of Voltmeter (Low range and High range).

UNIT-IV TRANSIENT AND ALTERNATING CURRENTS:

Growth and decay of current in a circuit containing resistance and inductance – growth and decay of charge in a circuit containing resistance and capacitor – growth and decay of charge in an LCR circuit (expressions for charge only) – peak, average and rms values of ac – LCR series and parallel circuits – resonance condition – Q factor – power factor.

UNIT-V MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES:

Maxwell's equations in vacuum, material media– physical significance of Maxwell's equations –displacement current - plane electromagnetic waves in free space.

TEXT BOOKS

1. Brij Lal, & N. Subrahmanyam, (2020). *A Textbook of Electricity and Magnetism*. S. Chand & Company Pvt. Ltd., New Delhi.
2. R. Murugeshan, (2017). *Electricity and Magnetism*. S. Chand & Company Pvt. Ltd., New Delhi.

REFERENCE BOOKS

1. M. Narayanamurthy, & N. Nagarathnam, (1992). *Electricity & Magnetism* (Revised ed.). NPC Publications.
2. D.L. Sehgal, K.L. Chopra, & N.K. Sehgal, (2020). *Electricity and Magnetism*. Sultan Chand & Sons, New Delhi.

WEB RESOURCES

1. https://youtu.be/yzgGHAoN_68
2. https://youtu.be/xxIb9Qv6t7E
3. https://youtu.be/kAOZZmMstX4

CORE PRACTICAL IV
ELECTRICITY AND MAGNETISM LAB

COURSE CODE: 24UPH554 (Practical)
CONTACT HOURS/WEEK:4 CREDIT: 2
INTERNAL MARKS: 40 EXTERNAL MARKS: 60

COURSE OUTCOMES:

CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Understand and apply core concepts of electricity and magnetism through experimentation.	K3
CO2	Use laboratory instruments such as multimeters, oscilloscopes, power supplies, and function generators.	K3
CO3	Apply theoretical knowledge to practical scenarios.	K3
CO4	Understand and measure electromagnetic induction, magnetic fields, and capacitance.	K3
CO5	Develop critical thinking and data analysis skills, including error analysis.	K4

LIST OF EXPERIMENTS:

1. Potentiometer – Calibration of low range voltmeter.
2. Potentiometer – Calibration of high range voltmeter.
3. Potentiometer – Calibration of ammeter.
4. Determination of earth's magnetic field using field along axis of current carrying coil.
5. Determination of specific resistance of the material of the wire using PO box.
6. Determination of resistance and specific resistance using Carey Foster's bridge.
7. Determination of rd specific resistance using Meter's bridge.
8. Determination of specific conductance of an electrolyte.
9. Determination of capacitance using Desauty's bridge and B.G.
10. Determination of figure of merit of BG or spot galvanometer.
11. Comparison of EMF of two cells using BG.
12. Comparison of capacitance using BG.
13. LCR- Series resonance circuit.
14. LCR-Parallel resonance circuit.
15. B.G – Determination of mutual inductance.
16. Potentiometer – Determination of resistance of a coil.
17. Potentiometer – emf of a thermocouple

TEXT BOOKS

1. S. Srinivasan. (2005). *A Textbook of Practical Physics*. S. Chand Publications, New Delhi.
2. Department of Physics, St. Joseph's College, Tiruchirappalli. (2009). *Practical Physics (B.Sc. Physics Main)*. St. Joseph's College Press, Tiruchirappalli.

REFERENCE BOOKS:

1. R. Sasikumar. (2011). *Practical Physics*. PHI Learning Pvt. Ltd., New Delhi.
2. Department of Physics, St. Joseph's College, Tiruchirappalli. (2009). *Practical Physics (B.Sc. Physics Main)*. St. Joseph's College Press, Tiruchirappalli.
3. S. Somasundaram. (2012). *Practical Physics*. Apsara Publications, Tiruchirappalli.

SEMESTER - V
GENERIC/CLUSTER CORE-III
ANALOG AND COMMUNICATION ELECTRONICS

COURSE CODE: 24UPS403
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	CO1	Explain the working, characteristics, and applications of diodes and rectifiers.	K1-K4
II	CO2	To understand & Analyze transistor characteristics, configurations (CB, CE, CC), and their operation in cutoff, active, and saturation regions.	K1-K4
III	CO3	To examine operational amplifier configurations, parameters, and applications such as summing, integrating, differentiating, and logarithmic amplifiers.	K1-K3
IV	CO4	To understand the principles of feedback and design of RC, LC, Wien-Bridge, Hartley, Colpitts, and phase-shift oscillators.	K1-K3
V	CO5	Explain modulation, demodulation, and pulse modulation techniques used in communication systems.	K1-K4

SYLLABUS

UNIT-I DIODES

Diodes-operation -V-I characteristics - half wave rectifier, centre tapped and bridge full wave rectifiers-calculation of efficiency and ripple factor-Diode Limiters and clampers - The Zener diode-Zener as a voltage regulator

UNIT-II TRANSISTOR CHARACTERISTICS

Junction Transistors--Transistor current components - Transistor as an amplifier -Transistor construction-Transistor configurations: Common Base Configuration-Common emitter configuration-The CE cutoff region-The CE Saturation region-The Common-collector configuration

UNIT-III BASIC OPERATIONAL AMPLIFIERS CIRCUITS

Introduction to Operational Amplifiers - Op-Amp Input modes and parameters-Negative Feedback -Op-Amps with negative feedback – Effects on Negative feedback on Op-Amp Impedances - Comparators-summing amplifiers-Integrators and Differentiators-Log and Antilog Amplifiers

UNIT-IV: OSCILLATORS

Oscillators - Feedback Oscillators-Oscillator with feedback circuits- RC feedback circuits-The Wien -Bridge oscillator- Phase shift oscillators- LC feedback circuits- Hartley& Colpitts Oscillator with mathematical analysis

UNIT-V MODULATION AND DEMODULATION

Modulation-Need for Modulation-Amplitude modulation - frequency modulation – comparison of AM and FM– phase modulation – sampling theorem – pulse width modulation– pulse modulation systems: PAM, PPM, and PCM– demodulation: AM and FM detection - super heterodyne receiver (block diagram)

TEXT BOOKS

1. Thomas L. Floyd, Electronic Devices Conventional Current version, Ninth Edition, Pearson Education. Inc,2015.
2. Jacob Millman, Integrated Electronics, Christos Halkais & Chetan Parikh, Second Edition, MC Graw Hill Education India Private Ltd, New Delhi,2016.
3. George Kennedy, Electronic communications Systems, Mc GRAW-Hill International editions, 2006.
4. V. K. Mehta & Rohit Mehta, Principles of Electronics, S. Chand & Company Ltd. 2008.

REFERENCE BOOK

1. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory Electronic Devices and Circuit Theory, 11th Edition, Pearson, 2013.
2. A. S. Sedra and K. C. Smith, Microelectronic Circuits, 7th Edition, Oxford University Press, 2014.

WEB RESOURCES:

1. **https://nptel.ac.in/**
2. **https://www.allaboutcircuits.com**
3. **https://onlinecourses.nptel.ac.in**

GENERIC/ CLUSTER CORE-IV
ASTROPHYSICS

COURSE CODE: 24UPS404
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO No.	Upon completion of this course, the students will be able to	Cognitive Level
I	CO1	Understand basic concepts of astronomy, celestial sphere, and light.	K1-K3
II	CO2	Explain principles of relativity, light–matter interaction, and telescopes.	K1-K3
III	CO3	Apply physical laws to study stars, stellar evolution, and the solar system.	K1-K3
IV	CO4	Analyze the structure and evolution of stars and galaxies.	K1-K3
V	CO5	Understand the large-scale structure of the universe and basic cosmology.	K1-K4

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

SYLLABUS

UNIT I – BASICS OF ASTRONOMY AND LIGHT

The Greek Tradition – Copernican Revolution – Celestial Sphere – Newtonian Mechanics – Kepler's Laws – Stellar Parallax – Magnitude Scale – Wave Nature of Light – Blackbody Radiation – Energy Quantization.

UNIT II – MODERN ASTROPHYSICS AND INSTRUMENTS

Lorentz Transformations – Basic Relativity – Spectral Lines – Photons – Bohr Model – Wave–Particle Duality – Optical Telescopes – Radio Telescopes – Modern Observational Methods.

UNIT III – THE NATURE AND EVOLUTION OF STARS

Binary Systems – Stellar Spectra – H–R Diagram – Stellar Atmospheres – Interiors of Stars – The Sun – Star Formation – Stellar Evolution – Stellar Pulsation – Massive Stars – White Dwarfs – Neutron Stars – Black Holes.

UNIT IV – THE SOLAR SYSTEM AND PLANETARY SCIENCE

Physical Processes – Tidal Forces – Planetary Atmospheres – Terrestrial Planets – Giant Planets – Moons – Ring Systems – Minor Bodies – Formation of Planetary Systems – Extrasolar Planets.

UNIT V – GALAXIES AND THE UNIVERSE

Milky Way Galaxy – Galaxy Types – Galactic Evolution – Structure of Universe – Expansion of Universe – Clusters – Active Galaxies – Quasars – Cosmology – Cosmic Microwave Background.

TEXT BOOKS

1. Carroll, B.W. & Ostlie, D.A., An Introduction to Modern Astrophysics, Pearson Education, 2017
2. Baidyanath Basu, An Introduction to Astrophysics, Second Printing, Prentice–Hall of India (P) Ltd, New Delhi, 2001.

REFERENCE BOOKS

1. Jones, M.H. & Lambourne, R.J.A., An Introduction to Galaxies & Cosmology, Cambridge University Press. Second edition, 2015.
2. Shu, F.H., The Physical Universe: An Introduction to Astronomy, University Science Books, 1982.
3. Motz, L. & Duveen, A., The Essentials of Astronomy, Columbia University Press, 1966.
4. Krishnaswamy, K.S., Astrophysics – A Modern Perspective, New Age International (P) Ltd, New Delhi, 2002.
5. Shylaja, B.S. & Madhusudan, H.R., Eclipse: A Celestial Shadow Play, Orient Black Swan, 1999.

WEB RESOURCES:

1. https://www.coursera.org/courses?query=astrophysics
2. https://www.space.com
3. https://www.britanica.com
4. https://science.nasa.gov
5. https://merriam-webster.com
6. http://digimat.in/nptel/courses/video/115105046/L13.html
7. https://nptel.ac.in/courses/115105046

DISCIPLINE CENTRIC CORE COURSE-V
ATOMIC AND MOLECULAR PHYSICS

COURSE CODE: 24UPH505
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

UNIT	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	**CO1**	Understand the structure of the atom, Bohr model, energy levels, and basic laser concepts.	K1-K3
II	**CO2**	Comprehend electron spin, quantum numbers, atom models, and magnetic properties of electrons.	K1-K3
III	**CO3**	Analyze atomic spectra, excitation/ionization potentials, Zeeman and Stark effects, and spectral notations.	K1-K3
IV	**CO4**	Explain molecular spectra, vibration-rotation spectra, electronic spectra, and molecular orbital theory.	K1-K3
V	**CO5**	Apply principles of rotational, vibrational, infrared, and Raman spectra in molecular analysis.	K1-K3

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze:

SYLLABUS

UNIT – I ATOMIC STRUCTURE

The Nuclear atom-Rutherford atomic Model -Alpha particle scattering experiment-Electron orbits -The Bohr atom-energy levels and Spectra-origin of line Spectra -Nuclear motion - Atomic excitation-Frank-Hertz experiment-The laser and its types (Ruby and He-Ne Laser)- Spontaneous and stimulated emission - Population inversion - Basic laser system - Applications

UNIT-II ATOM MODEL

Introduction to atom model – electron spin – spatial quantisation– quantum numbers– L-S and J-J coupling – Pauli's exclusion principle – magnetic dipole moment due to orbital motion and spin motion of the electron – Bohr magnetron – Stern-Gerlach experiment – selection rules – intensity rule.

UNIT-III ATOMIC SPECTRA

Origin of atomic spectra – excitation and ionization potentials – Davis and Goucher's method – spectral terms and notations – fine structure of Hydrogen atom– Zeeman effect –Larmor's

theorem – quantum mechanical explanation of normal Zeeman effect – anomalous Zeeman effect (qualitative explanation) –Paschen-Back effect – Stark effect.

UNIT – IV MOLECULAR PHYSICS

Molecular spectra – Theory of the pure rotational spectrum of a molecule - Theory of the origin of vibration –rotation spectrum of molecule - Electronic spectra of molecules - Molecular orbital theory of Hydrogen molecule ion .

UNIT – V ROTATIONAL AND VIBRATIONAL SPECTRA

Diatomic vibrating rotator-Theory of origin of the Vibration – Rotational Spectrum of a molecule (Carbon Monoxide) – Infrared spectra – Scattering of light –Raman effect– Classical and quantum theory of Raman effect – Applications of Raman effect .

TEXT BOOKS

1. Arthur Beiser, Concepts of Modern Physics, Seventh Edition, McGraw-Hill Higher Education (India) Private Limited, New Delhi, 2016
2. Harvey E. White Introduction to Atomic Spectra. B McGraw-Hill Book Company, N. Y. 1934
3. Banwell, C.N, Fundamentals of Molecular Spectroscopy,4th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995.
4. Robert L Brooks, The Fundamentals of Atomic and Molecular Physics, Springer, New York, 2014.
5. R. Murugesan, Kiruthiga Sivaprasath, Modern Physics (14th revised edition), S. Chand & Co Ltd., New Delhi, 2016.

WEB RESOURCES

1. https://www.pdfdrive.com/atomic
2. https://content.kopykitab.com
3. https://collegedunia.com
4. http://chem.libretexts.org

DISCIPLINE CENTRIC CORE COURSE-VI
CLASSICAL AND QUANTUM PHYSICS

COURSE CODE: 24UPH506
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	CO1	explain generalized coordinates, constraints, and apply Lagrangian formulation to solve mechanical systems	K1–K4
II	CO2	describe relativistic mechanics concepts and analyze oscillations and wave motion	K1–K4
III	CO3	understand Hamiltonian formulation and apply variational principles in mechanics	K1–K3
IV	CO4	explain fundamental concepts of quantum mechanics and interpret wave functions and operators	K1–K3
V	CO5	apply quantum mechanics to solve problems like particle in a box, harmonic oscillator, and atomic systems	K1–K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze**:**

SYLLABUS

UNIT I: FUNDAMENTAL PRINCIPLES AND LAGRANGIAN FORMULATION

Generalized coordinates and degrees of freedom - Constraints – Principle of virtual work - D'Alembert's principle- Lagrangian formulation of mechanics - Applications of Lagrange's equations – Simple Pendulum-Compound Pendulum-Atwood Machine.

UNIT II: RELATIVISTIC MECHANICS

Frame of reference- inertial and non-inertial frames- postulates of special theory of relativity Galelian Transformation- Postulates of Special theory of Relativity – Lorentz transformations (basic idea) - Time dilation and length contraction - Relativistic momentum and energy - Mass–energy equivalence.

UNIT III: HAMILTONIAN EQUATION OF MOTION

Legendre Transformation and the Hamiltonian Equations of motion- Cyclic Coordinates and Conservation Theorems - Routh' Procedure- The Hamiltonian formulation of Relativistic

Mechanics-Derivation of Hamilton's equations from Variational Principle-The Principle of Least Action.

UNIT IV: FUNDAMENTALS OF QUANTUM MECHANICS

Failure of classical physics - wave–particle duality - de Broglie hypothesis - Heisenberg Uncertainty Principle - Wavefunction and probability interpretation - Normalization and properties of wavefunction – Time dependent Schrödinger Equation - Time-independent Schrödinger equation - Operators - Eigenvalues and Eigen functions - expectation values.

UNIT V: APPLICATIONS OF QUANTUM MECHANICS

Applications of uncertainty principle- Particle in a one-dimensional box - Square well potential barrier - Linear harmonic oscillator - Hydrogen atom (basic solution) – The Rigid rotator.

TEXT BOOKS

1. Herbert Goldstein, Charles P. Poole Jr., and John L. Safko, *Classical Mechanics*, 3rd Edition, Pearson Education, New Delhi, 2002.
2. John R. Taylor, *Classical Mechanics*, University Science Books, 2005.
3. Arthur Beiser, Shobhit Mahajan, Rai Choudhury *Concepts of Modern Physics,* Mc Graw Hill Education, 20

REFERENCE BOOK

1. Upadhyaya J. C., *Classical Mechanics*, 2nd Edition, Himalaya Publishing House, New Delhi, 2005.
2. Mathews P. M. and K. Venkatesan, *A Textbook of Quantum Mechanics*, Tata McGraw-Hill, New Delhi, 1976.

WEB RESOURCES

1. https://ocw.mit.edu
2. https://nptel.ac.in
3. https://swayam.

CORE LABORATORY-V
ANALOG ELECTRONICS LAB

COURSE CODE: 24UPH555
CONTACT HOURS/WEEK: 04 **CREDIT: 02**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Understand the characteristics and applications of semiconductor devices such as diodes, transistors, and FETs.	K2
CO2	Analyze and construct rectifier, clipper, and clamper circuits for signal shaping and voltage regulation.	K4
CO3	Design and evaluate amplifier and oscillator circuits using BJTs and FETs to achieve desired gain and frequency response.	K5
CO4	Implement and test multivibrator circuits to generate stable and periodic waveforms using transistors and op-amps.	K3
CO5	Apply the operational amplifier for linear applications such as inverting, non-inverting, summing, and differential amplifiers.	K3

K2 – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

List of Experiments: (Any Ten)

1. Construct and study the performance of a Zener diode as a voltage regulator.
2. Construct and study the performance of a bridge rectifier using diodes (IN4007)
3. Construct and study the operation of clipping and clamping circuits using diodes.
4. Construct and study the input and output characteristics of a transistor in common-emitter (CE) configuration.
5. Construct and study the input and output characteristics of a transistor in common-base (CB) configuration.
6. Construct and study the performance of an RC coupled single-stage CE transistor amplifier.
7. Construct and study the operation and characteristics of a transistor emitter follower circuit.
8. Construct and study the performance of a Colpitt's oscillator using a transistor.
9. Construct and study the performance of a Hartley oscillator using a transistor.
10. Construct and study the operation of an astable multivibrator using transistors.
11. Construct and study the operation of a bistable multivibrator using transistors.
12. Construct and study the drain and transfer characteristics of a Field Effect Transistor (BFW 10).

13. Construct and study the performance of a FET amplifier in common-drain (source follower) configuration (BFW 10).
14. Construct and study the characteristics of a Unijunction Transistor (UJT 2N2646).
15. Construct and study the series resonance characteristics of an AC circuit containing L, C, and R components.

References:

1. Department of Physics, Practical Physics, (B.Sc. Physics Main), St. Joseph's College, Tiruchirapalli 2009.
2. S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005.
3. Dr. S. Somasundaram, Practical Physics, Apsara Publications, Tiruchirapalli, 2012.
4. C.C. Ouseph, U.J. Rao and V. Vijayendran, Practical Physics and Electronics, Viswanathan Printers and Publishers, PVT Ltd (www.svprinters.com), Chetpet, Chennai, 2014

DISICIPLINE CENTRIC ELECTIVE
COSMOLOGY AND ASTRONOMY

COURSE CODE: 24UPH701
CONTACT HOURS/WEEK: 04 **CREDIT: 04**

Course Outcomes:

Unit	CO No.	Upon completion of this course, the students will be able to:	Cognitive Level
I	CO1	Understand basic astronomy concepts and observations.	K1 – K3
II	CO2	Explain the Sun and solar system.	K1 - K4
III	CO3	Describe exoplanets and observational methods.	K1 - K4
IV	CO4	Analyze stellar properties and evolution.	K1 - K4
V	CO5	Understand cosmology, dark matter, and dark energy.	K1 - K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze:

SYLLABUS

UNIT I – ASTRONOMY AS AN OBSERVATIONAL SCIENCE

Introduction – basics and copernican proof – celestial sphere and magnitudes – sky mapping and star brightness – coordinates, precession and time – position and time measurement – planetary motion – Brahe and Kepler laws – gravitation and relativity – Newton's gravity and Einstein's theory.

UUNIT II – THE SOLAR SYSTEM AND THE SUN

Formation of the solar system– origin of solar system and basic properties of the sun – solar energy and composition – radiation and spectral lines – nuclear fusion – energy production in the sun – solar atmosphere – photosphere, corona, and solar wind – solar activity – sunspots and flares – planets and comets – properties of planets and small bodies.

UNIT III: EXOPLANETS AND MODERN ASTRONOMICAL OBSERVATION

Radial velocity and pulsar planets – doppler method and pulsar detection – planetary transits and microlensing – transit and lensing methods – astrometry and discovery space – position-based detection and limits – selection effects – finding solar-like systems – optics and imaging – mirrors, lenses, and image formation – telescopes – types of telescopes and observations.

UNIT IV: STELLAR PROPERTIES AND STELLAR EVOLUTION

Luminosity and distance – stellar brightness and distances – magnitudes and motion – proper motion and magnitude scale – temperature and spectra – colour and spectral types – H–R diagram – classification of stars – stellar properties – size, mass, and lifetime – stellar evolution – life cycle, supernovae and black holes.

UNIT V: COSMOLOGY AND THE EVOLUTION OF THE UNIVERSE

Big bang models and expansion – origin of the universe, redshift, and expansion – cosmological models – big bang and steady state theories – cosmic microwave background – discovery and features of CMB radiation – inflation and nucleosynthesis – early universe expansion and formation of elements – dark matter and dark energy – evidence and role in the universe – universe and life – structure, multiverse ideas, and future of the universe.

TEXT BOOK

1. Morison, I., Introduction to Astronomy and Cosmology, John Wiley & Sons Ltd., Chichester, United Kingdom, 2008.

REFERENCE BOOKS

1. Narlikar, J. V., Seven Wonders of the Cosmos, Cambridge University Press, 1999.
2. Arny, T. & Schneider, S., Explorations: Introduction to Astronomy, McGraw Hill, 2016.
3. Abhyankar, K. D., Astrophysics: Stars and Galaxies, University Press, 2001.
4. Basu, B., An Introduction to Astrophysics, Prentice Hall of India Pvt. Ltd. 2011.
5. Shu, F. H., The Physical Universe: An Introduction to Astronomy, University Science Books, 1982.
6. Carroll, B. W. & Ostlie, D. A., An introduction to Modern Astrophysics, Addison-Wesley Publishing Co. 2014
7. Zeilik, M. & Gregory, S. A., Introductory Astronomy and Astrophysics, Saunders College Publishing, 1998.

WEB SOURCES:

3. https://archive.nptel.ac.in/content/syllabus_pdf/115105046.pdf
4. https://www.cosmos.esa.int/gaia
5. https://phys.libretexts.org/Bookshelves/Astronomy__Cosmology

DISICIPLINE CENTRIC ELECTIVE LABORATORY
ASTROPHYSICS SIMULATION LAB

COURSE CODE: 24UPH751
CONTACT HOURS/WEEK: 04 **CREDIT: 02**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO No.	Upon completion of this course, the students will be able to	Cognitive Level
CO1	Identify basic celestial objects such as constellations, stars, and planets.	K1
CO2	Explain the motion of the Sun, Moon, and planets using observations and simulations.	K2
CO3	Perform simple astronomical measurements such as solar altitude and angular distance.	K3
CO4	Analyze astronomical phenomena like retrograde motion and phases of the Moon using Stellarium.	K4
CO5	Interpret observational data and relate it to theoretical concepts in astronomy.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K4 – Analyze

List of Experiments (any ten)

1. Study of constellations and identification of major stars.
2. Study of phases of the Moon by observation and recording.
3. Measurement of solar altitude using a simple gnomon.
4. Construction and calibration of a simple sundial.
5. Study of apparent motion of the Sun using Stellarium.
6. Observation of planetary motion using Stellarium.
7. Study of retrograde motion of planets using Stellarium.
8. Measurement of angular distance between celestial objects using Stellarium.
9. Identification of bright stars using Stellarium.
10. Study of deep sky objects (galaxies, nebulae, clusters) using Stellarium.
11. Study of celestial coordinate systems using Stellarium.
12. Observation of meteor showers and radiant points using Stellarium.

Software Requirements

- Stellarium for sky simulation,
- SAOImage DS9 for image analysis,
- Python (with Astropy) for data analysis

Web resources:

1. https://stellarium.org/
2. https://www.amusecode.org/

DISCIPLINE CENTRIC ELECTIVE - I
FUNDAMENTALS OF MEDICAL PHYSICS

COURSE CODE: 24UPH703
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	CO1	Explain the characteristics and applications of non-ionizing radiation and understand the principles and medical uses of lasers.	K1-K3
II	CO2	Describe the sources, effects, and interactions of ionizing radiation with matter and apply protection principles.	K1-K3
III	CO3	Interpret various radiation quantities, units, and dosimetric measures relevant to medical applications.	K1-K3
IV	CO4	Analyze the physical principles behind diagnostic imaging systems such as X-rays, CT, MRI, and ultrasound.	K1-K3
V	CO5	Evaluate the working principles of radiotherapy units and demonstrate understanding of safety and quality assurance in clinical settings.	K1-K3

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

SYLLABUS

UNIT-I: NON-IONIZING RADIATION

Electromagnetic spectrum - Sources of non-ionizing radiation – Radio frequency – Microwaves – Infrared radiation – Visible radiation – Ultraviolet radiation – Laser systems: principle – Types of lasers – Biomedical applications – Safety aspects in non-ionizing radiation

UNIT-II: IONIZING RADIATION

Radiation sources – Exposure to ionizing radiation – Health effects of ionizing radiation – Interaction of electromagnetic radiation with matter– Photoelectric effect– Compton scattering– Energy absorption – Linear energy transfer – Radiation protection principles

UNIT-III: RADIATION QUANTITIES AND UNITS

Particle flux and fluence – Energy flux and fluence – Linear attenuation coefficient – Mass attenuation coefficient– Mass energy transfer coefficient – Mass energy absorption coefficient – Stopping power – Linear energy transfer– Absorbed dose – Kerma – Exposure

UNIT-IV: MEDICAL PHYSICS IN DIAGNOSTIC RADIOLOGY

Discovery of X-rays – Production of X-rays – Properties of X-rays – Characteristics of X-rays – Different modalities of X-rays – Fluoroscopy – Mammography– C-arm – Digital radiography – Computed tomography (CT) – Different generations of CT – Nuclear medicine – Magnetic Resonance Imaging (MRI): basic principles and instrumentation– Ultrasound imaging– Doppler effect in medical diagnostics

UNIT-V: MEDICAL PHYSICS IN RADIOTHERAPY APPLICATIONS

Telecobalt units: construction and working – Linear accelerator: principle and function – Basics of brachytherapy – Radiation protection in radiotherapy– Quality assurance in radiotherapy

Text Books:

4. Stewart C. Bushong, Radiologic Science for Technologists: Physics, Biology, and Protection, 11th Edition, Elsevier, New Delhi, 2016.
5. Faiz M. Khan (original author) / John P. Gibbons (editor), Khan's The Physics of Radiation Therapy, 6th Edition, Wolters Kluwer Health / Lippincott Williams & Wilkins, New Delhi / Philadelphia & Baltimore, 2019.

Web resources:

1. https://www.epa.gov/radtown/non-ionizing-radiation-wireless-technology
2. https://scfhs.org.sa/sites/default/files/2024-11/Medical_Physics_for_Diagnostic_Radiology_Residency_Program_Curriculum_18%20Nov%2024_0.pdf

ELECTIVE PRACTICAL
MEDICAL INSTRUMENTATION

COURSE CODE: 24UPH752 (PRACTICAL)
CONTACT HOURS/WEEK:4 CREDITS: 2
INTERNAL MARKS: 40 EXTERNAL MARKS: 60

COURSE OUTCOMES

CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Perform and interpret ABO, Rh blood grouping, and vital signs measurement using medical equipment.	K3
CO2	Analyze blood test results, including RBC, WBC, platelet counts, hemoglobin, bleeding, and clotting times	K4
CO3	Acquire and interpret simulated CT images, understanding basic principles of computed tomography.	K3
CO4	Set up and calibrate an X-ray system, ensuring accurate imaging and adherence to safety protocols.	K4
CO5	Operate ultrasound machines in different modes to perform precise diagnostic imaging.	K3

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

EXPERIMENTS: (ANY 6)

1. Blood Groups - ABO and RH grouping estimation
2. Measurement of Blood pressure, heart rate, pulse rate, reflexes
3. Measurement of RBC, WBC, Platelet count
4. Measure of bleeding time and clotting time
5. Hemoglobin test
6. Simulated CT image acquisition
7. Setting up an X-ray imaging system
8. Determination of Heart Rate Using ECG Simulation
9. Ultrasound Imaging Demonstration (Basic Mode)
10. Pulse Oximetry Measurement
11. X-ray Image Observation (Demo)
12. Measurement of Respiratory Rate

REFERENCES:

1. Arlene M. Adler, Richard R. Carlton & Kori L. Stewart, Introduction to Radiologic and Imaging Sciences and Patient Care, 8th Edition, Elsevier, 2021.
2. John E. Hall, "Guyton and Hall Textbook of Medical Physiology," Elsevier, 14th Edition (2020).
3. William R. Hendee and E. Russell Ritenour, "Medical Imaging: Principles and Practices," Wiley, 5th Edition (2020).

INTRODUCTION TO MATERIALS SCIENCE

COURSE CODE: 24UPH705

CONTACT HOURS/WEEK: 4 **CREDIT: 4**

INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

UNIT	CO No	Upon completion of this course, the students will be able to	Cognitive Level
I	CO1	Explain the fundamental concepts of materials, classify them, and analyze atomic bonding and interatomic forces in solids.	K1–K4
II	CO2	Describe crystal structures, unit cells, crystallographic planes and directions, and apply these concepts to analyze close-packed structures.	K1–K4
III	CO3	Explain point, line, surface, and volume defects in crystals and evaluate their effect on material properties using microscopic techniques.	K1–K4
IV	CO4	Interpret mechanical properties of metals, including stress–strain behavior, elastic and plastic deformation, and evaluate hardness, tensile, compressive, and torsional responses.	K1–K4
V	CO5	Classify optical properties of materials, explain light–matter interactions, and analyze applications such as luminescence, photoconductivity, and optical fiber communication.	K1–K4

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

SYLLABUS

UNIT-I : INTRODUCTION TO MATERIALS

Introduction to material and Material science-classification of materials-Advanced materials-bonding in solids: bonding forces and energies, primary bonds, secondary bonds.

UNIT-II: STRUCTURE OF CRYSTALLINE SOLIDS

Crystal structures: fundamental concepts, unit cells, metallic crystal structures, polymorphism and allotrophy - crystallographic points, directions and plane: point co-ordinates, crystallographic directions crystallographic planes, linear planar densities-closed packed crystal structures.

UNIT-III: CRYSTAL IMPERFECTIONS

Point defects: vacancies and self-interstitials, impurities in solids specification of composition-miscellaneous imperfections: dislocations-linear defects, interfacial defects, bulk and volume defects, microscopic examination: basic concepts of microscopy-microscopic techniques-grain size determination.

UNIT-IV: MECHANICAL PROPERTIES OF METALS

Concepts of stress and strain-elastic deformation: stress –strain behaviour-elastic properties of materials--tensile properties--elastic recovery after plastic deformations--compressive, shear and torsional deformations-hardness.

UNIT V OPTICAL PROPERTIES

Electromagnetic radiation-light interactions with solids-atomic and electronic interactions-optical properties: refraction-reflection-absorption-transmission-Applications: luminescence - photoconductivity-optical fiber communications.

TEXT BOOK

1. William D. Callister, Jr., David G. Rethwish, Materials Science and Engineering An Introduction, Wiley publications, 2014.

REFERENCE BOOKS

1. Material science and Engineering, Raghavan V, Prentice Hall of India, Sixth Edition, 2015
2. Materials science, V. Rajendran, McGraw Hill publications 2011.
3. S.O. Pillai, Solid State Physics, Wiley Easter Ltd. (1994)

WEB RESOURCES:

1. https://courseware.cutm.ac.in/wp-content/uploads/2020/05/crystal-imperfections-2.pdf
2. https://ocw.mit.edu/courses/3-012-fundamentals-of-materials-science-fall-2005/
3. https://www.uu.se/en/study/syllabus?query=51012&utm_
4. https://ocw.uc3m.es/mod/page/view.php?id=1610&utm

EXPERIMENTAL NANOTECHNOLOGY LAB

COURSE CODE: 24UPH753
CONTACT HOURS/WEEK:4 **CREDIT: 2**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Synthesize various nanoparticles (metal, metal oxide, ferrite, bimetallic, sulfide, perovskite, nanocomposite) using cost-effective and green methods.	K6
CO2	Apply different synthesis techniques such as co-precipitation, sol-gel, hydrothermal, chemical reduction, combustion, and wet-chemical methods.	K3
CO3	Prepare nanocomposites and thin films for functional applications.	K6
CO4	Characterize nanoparticles to study their structure, morphology, and properties.	K4
CO5	Develop practical skills and problem-solving ability in nanoparticle synthesis and applications.	K5

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create

LIST OF EXPERIMENTS: (Choose Any one Synthesis Technique)

1. Synthesis of Bimetallic Nanoparticles by Wet Chemical Method.
2. Synthesis of Metal Oxide Nanoparticles by Co-precipitation Method.
3. Synthesis of Metal Oxide Nanoparticles by Sol-Gel Method.
4. Synthesis of Metal Nanoparticles by Chemical Reduction Method.
5. Synthesis of Metal Oxide Nanoparticles by Hydrothermal Method.
6. Synthesis of Ferrite Nanoparticles by Co-precipitation Method.
7. Synthesis of Metal Nanoparticles by Green Method.
8. Synthesis of Perovskite Materials by Co-precipitation Method.
9. Synthesis of Metal Sulfide Nanoparticles by Co-precipitation method.
10. Synthesis of Bimetallic Nanoparticles by Wet-Chemical Method.
11. Synthesis of Nanocomposite Nanoparticles by Sol-Gel Method.
12. Synthesis of Metal Oxide Nanoparticles from Combustion method.
13. Deposition of Metal oxide thin films by spray pyrolysis method.
14. Deposition of Metal sulphide thin films by SILAR method.
15. Deposition of Metal sulphide thin films by Chemical bath deposition technique.

Text Books:

1. Charles P. Poole Jr. and Frank J. Owens, Introduction to Nanotechnology, Wiley Publications, 2003.

2. Mick Wilson, Kamali Kannagara Geoff Smith, Michelle Simmons & Burkhard Raguse, Nanotechnology Basic Science and Emerging Technologies, Overseas Press India Private Limited, 2005.

FUNDAMENTALS OF OPTO – ELECTRONICS

COURSE CODE: 24UPH707
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO No.	Upon completion of this course, students will be able to	Cognitive Level
I	CO1	Understand basic communication concepts including analog and digital signals, electromagnetic spectrum and multiplexing techniques.	K1-K4
II	CO2	Explain optical communication systems and fiber Principles including light propagation, fiber losses, and WDM technology	K1-K4
III	CO3	Analyze optical fiber cables and structures for different applications such as indoor, outdoor and underwater communication system.	K1-K4
IV	CO4	Describe the working of optical sources and transmitters, including LED's laser diodes, and different laser technologies.	K1-K4
V	CO5	Evaluate photodetectors and optical receivers, including PIN and avalanche photodiodes, noise analysis and receiver performance	K1-K4

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

Syllabus

UNIT I BASIC CONCEPTS OF COMMUNICATION SYSTEMS

Definitions - Analog Signal - Digital Signal - Digitization of Analog Signals - Electromagnetic Spectrum - Telecommunication Spectral Band - Optical Communications Band - Transmission Channels - Carrier Waves- Baseband Signals - Signal Multiplexing

UNIT II OPTICAL COMMUNICATION SYSTEMS AND OPTICAL FIBERS

Evolution of Optical Communications - Elements of an Optical Link - WDM Concept - Applications of Optical Fiber - Optical Networking and Switching - Light Propagation in Fibers- Optical Fiber Modes - Single-Mode Fibers –Multi-mode Fiber- Fiber losses-Optical Fiber Attenuation - Fiber Information Capacity - Optical Fiber Standards

UNIT III OPTICAL FIBER CABLES

Fiber Strength - Dielectric Nature of Fibers - Small Size and Low Weight - Cable Materials and Structures - Tight-Buffered Fiber Cable -- Loose-Tube Cable Configuration - Ribbon Cable - Indoor Cables - Indoor Cable Designs - Indoor Cable Applications - Outdoor Cables Aerial Cable - Armored Cable- Underwater Cable - Military Cable

UNIT IV LIGHT SOURCES AND TRANSMITTERS

Principles of Operation - Surface Emitters - Edge Emitters - Laser Diodes - Fabry-Perot Laser - Distributed-Feedback Laser - Tunable Lasers - Vertical Cavity Surface Emitting Laser -

Pump Lasers - Optical Transmitters - LED Transmitters - Laser Transmitters - Transmitter Controllers - Transmitter Packages

UNIT V PHOTODIODES AND RECEIVERS

The pin Photodiode - Operation of a pin Photodiode - Photo detector materials-Quantum efficiency - Responsivity - Speed of response - Bandwidth - Avalanche Photodiodes - Comparisons of photo detectors -. Optical Receiver - Photo detector Noise -Noise Sources

Text Books:

1. Keiser, G. *Optical Fiber Communications*. McGraw-Hill, 2003.

Reference books:

1. Clifford R.Pollock , Fundamentals of Optoelectronics Irwin Chicago, 1995

Web Resources:

1. SPIE Digital Library (Optics & Photonics): https://spie.org
2. National Digital Library of India: https://ndl.iitkgp.ac.in
3. NPTEL Courses on Lasers & Fibre Optics: https://nptel.ac.in

OPTOELECTRONICS LAB

COURSE CODE: 24UPH754
CONTACT HOURS/WEEK: 04 **CREDIT: 02**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

CO No.	Upon completion of this course, the students will be able to	Cognitive Level
CO1	Understand and measure I–V characteristics of LEDs and laser diodes.	K3
CO2	Analyze optical power and spectrum characteristics of light sources.	K2
CO3	Determine and verify optical parameters such as numerical aperture and beam divergence.	K4
CO4	Study the characteristics of photodetectors and solar cells.	K4
CO5	Design, simulate, and test optoelectronic circuits for signal detection and communication.	K6

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

List of Experiments (Any Ten)

1. Study of I–V Characteristics of Light Emitting Diode (LED).
2. Study of Voltage vs. Optical Intensity Characteristics of a Semiconductor Laser Diode.
3. Measurement of Optical Power Output of an LED.
4. Measurement of Optical Spectrum of an LED using Spectrometer.
5. Verification of Malus Law for Plane Polarized Light.
6. Study of I–V Characteristics of Photodiode.
7. Study of Photo Transistor Characteristics under varying illumination.
8. Determination of Numerical Aperture (NA) of an Optical Fiber.
9. Measurement of Bending Loss in Optical Fiber.
10. Verification of Inverse Square Law using a Photodetector.
11. Study of Solar Cell Characteristics and determination of Fill Factor (FF) and Efficiency.
12. Measurement of Beam Divergence and Spot Size of Laser Diode.
13. Characterization of Laser Diffraction Grating using Semiconductor Laser.
14. Observation of Electro-Optic Effect using Laser Diode setup.
15. DC Characteristics of Laser Diode using Semiconductor Parameter Analyzer.
16. VI characteristics of solar cell.

DISCIPLINE CENTRIC ELECTIVE COURSE

MICRO PROCESSOR AND MICRO CONTROLLER

COURSE CODE: 24UPH709
CONTACT HOURS/WEEK: 04 **CREDIT: 04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

Unit	CO No.	Upon completion of this course, the students will be able to	Cognitive Level
I	**CO1**	Explain the architecture, programming model, and instruction set of the 8085 microprocessor	K2-K4
II	**CO2**	Describe the architecture, register organization, and memory segmentation of the 8086 microprocessor	K2-K4
III	**CO3**	Apply 8086 assembly language programming concepts to develop and debug simple programs	K3-K4
IV	**CO4**	Analyze the hardware architecture and functional components of the 8051 microcontroller	K3-K4
V	**CO5**	Apply instruction sets and operations of 8051 to design basic embedded programs	K3-K4

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create

Syllabus

UNIT – I 8085 MICROPROCESSOR ARCHITECTURE AND ITS OPERATION
Microprocessor – Binary Digits – Microprocessor as a Programmable Device – Memory – Microprocessor as a CPU – 8085 Programming Model (Architecture)– Data Transfer operations – Arithmetic Operations - Logical Operations – Branching Operations – 8085 Instruction Set – Data Transfer Instructions – Arithmetic Instructions – Logic and Bit manipulation Instruction – Branch Instructions.

UNIT – II 8086 ARCHITECTURE AND REGISTERS
Organization of the 8086 CPU (Architecture) – The Instruction Pointer – Flags – The 'A' Registers: AX, AH, AL – The Stack pointer – General Purpose Register – Pointing Register – Segmented Memory – Segmented Registers CS, DS, SS, and ES – Physical Memory Addresses – Logical Memory Addresses – Offset Address – Legal segment Register – offset Register combinations – Word on Notation.

UNIT - III 8086 PROGRAMMING TECHNIQUES
Designing the Program – Writing and Testing the Program – 8086 Programming Lines of code – Addressing Modes – Assembling and Debugging – Instructions – Flow Charts – Sequential Program – Packed Number addition – Word Addition – Unpacked Number Addition – Indirect addressing – Looping programs – Loop Counts up – Loop Counts down – End Loop at Limit – Names for Constants – Variables and Data segments.

UNIT - IV 8051 MICROCONTROLLER HARDWARE ARCHITECTURE
8051 Microcontroller Hardware - 8051 Oscillator and Clock – Program Counter and Data Pointer - A and B CPU registers – Flags and the Program Status word – Internal Memory-

Internal RAM - The Stack and The Stack Pointer – Special Function Register – Internal ROM- Inout/output Pins, Ports and Circuits – External Memory – Counters and Timers – Serial Data Input /output – Interrupts.

UNIT – V 8051 MICROCONTROLLER OPERATIONS AND INSTRUCTIONS

Addressing Modes – External Data moves – Code Memory Read Only Data Moves – Push and Pop Opcodes – Data Exchanges – Byte level and Bit level Operation – Rotate and Swap Operations – Flags - Incrementing and Decrementing – Addition – Subtraction – Multiplication and Division – Jump and Call program range – Jumps – Calls and Subroutine – Interrupts and Returns.

Text Books

1. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085. 5th Edition, Penram International Publishing (India) Pvt Ltd. 2011. (Unit I)
2. Kenneth. J. Ayala, The 8086 Microprocessor Programming & Interfacing The PC, 11th Edition Delmar Learning, 2013. (Unit II & Unit III)
3. Kenneth. J. Ayala, The 8051 Microcontroller, 3rd Ed., Cengage Learning, 2014. (Unit IV & Unit V)

Web Resources

1. https://nptel.ac.in/courses/108105102
2. https://www.youtube.com/watch?v=4pTiujyY4IM

MICROPROCESSOR AND MICROCONTROLLER LAB

COURSE CODE: 24UPH755
CONTACT HOURS: 4 **CREDITS: 2**
INTERNAL MARKS: 40 **EXTERNAL MARKS:60**

COURSE OUTCOMES:

CO No.	Upon completion of this course, the students will be able to	Cognitive Level
CO-1	Write and execute assembly language programs for basic arithmetic and logical operations using 8085 microprocessor.	K3
CO-2	Develop programs for data handling, including finding the largest and smallest numbers and generating series like Fibonacci and factorial.	K3
CO-3	Perform code conversion between ASCII and Binary formats using 8085 microprocessor.	K3
CO-4	Execute arithmetic and logical operations using 8051 microcontroller and organize data in ascending or descending order.	K3
CO-5	Interface 8051 with peripheral devices such as ADC, DAC, and stepper motor, and develop simple applications like a digital clock.	K4

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

List of Programmes:

Microprocessor Lab

1. Develop an 8085 assembly program to perform 8-bit addition and subtraction and store the result with flags.
2. Implement an 8085 program to perform 8-bit multiplication and division using suitable methods.
3. Design an 8085 program to find the largest and smallest numbers in a given data array.
4. Construct 8085 programs to generate the Fibonacci series and compute the factorial of a number.
5. Create an 8085 program to convert ASCII data to binary and binary to ASCII.

Microcontroller 8051 Lab

1. Develop an 8051 program to perform 8-bit arithmetic operations (addition, subtraction, multiplication, and division).
2. Implement logical operations such as AND, OR, and NOT using an 8051 program.
3. Design an 8051 program to arrange a set of numbers in ascending order
4. Construct an 8051 program to arrange a set of numbers in descending order.
5. Interface an ADC with 8051 and acquire analog input data through a suitable program.
6. Generate analog output by interfacing a DAC with 8051 using an appropriate program.
7. Create a digital clock using 8051 and display time continuously.
8. Control a stepper motor using 8051 through proper interfacing and programming.

Text Books

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, 6th Edition, Penram International Publishing, 2013.

2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education, 2011.

Web Resources

1. https://nptel.ac.in/courses/108105102
2. https://nptel.ac.in/courses/117105126
3. https://nptel.ac.in/courses/108105057
4. https://www.youtube.com/c/NesoAcademy
5. https://www.youtube.com/c/ALLABOUTELECTRONICS
6. https://www.youtube.com/c/GateSmasher
7. https://www.youtube.com/@Techgurukul

DISCIPLINE CENTRIC ELECTIVE

DIGITAL ELECTRONICS

COURSE CODE: 24UPH711
CONTACT HOURS/WEEK: 04 **CREDIT:04**
INTERNAL MARKS: 25 **EXTERNAL MARKS: 75**

COURSE OUTCOMES:

UNIT	CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
I	CO1	Convert numbers between different bases and apply codes and Boolean algebra to simplify logic expressions.	K1-K3
II	CO2	Design and implement basic arithmetic circuits using logic gates.	K1-K4
III	CO3	Analyze and design combinational logic systems such as adders, multiplexers, and decoders.	K1-K3
IV	CO4	Construct and analyze sequential logic circuits using latches, flip-flops, registers, and counters.	K1-K3
V	CO5	Describe the structure and operation of various memory devices and their applications in digital systems.	K1-K4

K1- Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

SYLLABUS

UNIT – I NUMBER SYSTEMS, CODES

Number System: Binary Numbers - Number base conversions - 1'S complement and 2'S Complement - Binary code: BCD Code, Excess -3.

UNIT – II LOGIC GATES & BOOLEAN ALGEBRA

Logic Gates: OR, AND, NOT, NAND, NOR, EX-OR and EX-NOR gates - NAND and NOR as universal gate - Laws of Boolean Algebra - De-Morgan's Theorems - SOP forms of expressions (minterms) – Karnaugh map simplification (Four variables).

UNIT – III COMBINATIONAL LOGIC CIRCUITS

Arithmetic Circuits: Binary Adders and Subtractors –Decimal Adder-Binary Multiplier , BCD Adder –Multiplexer – Demultiplexers - Encoders and Decoders.

UNIT – IV SEQUENTIAL LOGIC CIRCUITS

Sequential Circuits: Flips-Flops – RS, JK, Master-Slave JK, D & T flip flops- Registers: Shift Registers - Ripple Counters - Mod-10 counter - Synchronous counters - asynchronous counters.

UNIT – V MEMORY

Memory organization -Magnetic Memory - Optical Memory - ROM, PROM, DROM, EPROM, EEPROM, RAM , expansion of memory .

TEXT BOOKS

1. Malvino and Leach, Digital Principles and Applications, 7th Edition, McGraw-Hill Education, (2011)
2. M. M. Mano and M. D. Ciletti, Digital Design, 5th Ed. Pearson Education, (2012)
3. Z. Kohavi and N. K. Jha, Switching theory and Finite Automata Theory, 3rd Ed. (Cambridge, 2010).
4. S. Goshal, Digital Electronics, (Cambridge, 2012).
5. Anil K. Maini, Digital Electronics Principles Devices and Applications, (Wiley, 2007)
6. V.K.Metha, Principles of Electronics, S. Chand and Co Ltd., (2013)
7. Anokh Singh and Chopra A.K., Principles of communication Engineering, S.Chandand Co, (2013)
8. P.S.Manoharan,Digital Principels & System Design, Charulatha Publication,(2013)

WEB RESOURCES

1. https://www.classcentral.com/course/youtube-digital-electronics-48205
2. https://www.youtube.com/watch?v=DBTna2ydmC0
3. https://nptel.ac.in/courses/108105132

DIGITAL CIRCUITS LAB

COURSE CODE: 24UPH756 (PRACTICAL)
CONTACT HOURS/WEEK: 04 CREDIT: 02
INTERNAL MARKS: 40 EXTERNAL MARKS: 60

COURSE OUTCOMES:

CO. NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO1	Analyze and verify the functionality of fundamental logic gates (AND, OR, NOT, NAND, NOR, XOR) through truth tables	**K4**
CO2	Design and verify half/full adder, half/full subtractor, using truth tables.	K6
CO3	Design and implement RS and JK flip-flops using basic/ universal gates.	K6
CO4	Implement parallel-in parallel-out shift register using 7495 IC and 4-bit shift register using flip-flops.	K3
CO5	Design and implement decade, up-down, ring, and ripple counters using flip-flops.	K6

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**-Create

List of Experiments: (Any Ten)

1. Study and verify truth tables of AND, OR, NOT, NAND, NOR and XOR gates
2. Construct NAND as a Universal Gate.
3. Construct NOR as a Universal Gate.
4. Verify Demorgan's theorem.
5. Truth table verification of Half adder and Full adder
6. Truth table verification of Half subtractor and Full subtractor
7. Construct 4:1 Multiplexer and 1:4 Demultiplexer
8. Construct 4x2 Encoder and 2x4 Decoder
9. Design and Implement of J-K Flip flop.
10. Design and Implement of RS Flip Flop
11. Parallel-in and Parallel-out Shift register using 7495 IC
12. Design and Implement a 4 bit shift register using Flip flops
13. Design and Implement a Decade counter
14. Design and Implement the Up-Down counter.
15. Design and Implement the Ring Counter
16. Design and Implement the Ripple Counter.

REFERENCES:

1. Department of Physics, *Practical Physics*, (B.Sc. Physics Main), St. Joseph's College, Tiruchirapalli 2009
2. Dr. S. Somasundaram,(2012) Practical Physics, Apsara Publications, Tiruchirapalli,.
3. C.C. Ouseph, U.J. Rao and V. Vijayendran, (2014) *Practical Physics and Electronics*, Viswanathan Printers and Publishers, PVT Ltd (www.svprinters.com), Chetpet, Chennai
4. S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005
5. R. Sasikumar, (2011) *Practical Physics*, PHI Learning Pvt. Ltd, New Delhi.

DISCIPLINE CENTRIC ELECTIVE
TEACHING OF PHYSICS

COURSE CODE: 24PH757
CONTACT HRS: 04 **CREDITS: 02**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO	Upon Completion of this course the students will be able to	Cognitive Level
CO1	Design and develop effective Physics lesson plans with clear objectives, appropriate teaching methods, and evaluation techniques	K1 – K4
CO2	Demonstrate essential teaching skills such as explanation, questioning, reinforcement, and use of teaching aids through microteaching and classroom practice	K1 – K4
CO3	Apply assessment strategies, conduct laboratory activities, and analyze student learning difficulties to improve teaching effectiveness	K1 – K4

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze

Syllabus

Module I: Planning of Instruction (Lesson Planning)

- Preparation of 5–10 lesson plans
- Clear learning objectives (cognitive, affective, psychomotor)
- Selection of appropriate teaching methods
- Use of teaching aids and activities
- Integration of evaluation techniques

Module II: Microteaching Sessions

- Skill of explanation (laws, principles, derivations)
- Skill of questioning (conceptual, analytical, numerical)
- Skill of reinforcement (positive feedback)
- Skill of blackboard usage (diagrams, graphs, ray diagrams)
- Skill of stimulus variation (voice, gestures, interaction)

Module III: Classroom Teaching Practice

- Teaching peers and real students
- Use of interactive strategies (discussion, demonstration, problem-solving)
- Classroom management techniques
- Addressing diverse learners and misconceptions

Module IV: Demonstration and Laboratory Work

- Demonstration of at least 3–5 experiments

- Conducting student-centered lab activities
- Maintenance of lab records and safety measures
- Linking experiments with theory

Module V: Preparation and Use of Teaching Aids

- Charts (laws, formulas, diagrams)
- Models (working/non-working models)
- ICT tools (PPTs, simulations, PhET, virtual labs, AI tools)
- Improvised/low-cost teaching aids

Module VI: Assessment and Evaluation

- Formative assessment (oral questions, quizzes, observation)
- Summative assessment (tests, exams, practicals)
- Assignments, lab reports, and projects
- Diagnostic testing and remedial teaching
- Peer and self-assessment
- Use of rubrics and grading criteria

Module VII: Pedagogical Analysis of Physics Content

- Breaking topics into teachable units
- Identifying key concepts, laws, and principles
- Anticipating student difficulties and misconceptions
- Sequencing content logically

Module VIII: Professional Skills and Reflective Practice

- Self-evaluation of teaching
- Maintaining teaching diary/records
- Feedback from supervisors
- Continuous improvement in teaching methods

Reference Books

1. S.K., Kochhar., Methods and Techniques of Teaching, Sterling Publishers Pvt. Ltd., New Delhi,
2. K.K.Sharma , Teaching of Physical Science, Vikas Publishing House Pvt. Ltd., New Delhi,
3. **Web Resources**
4. DIKSHA Platform – https://diksha.gov.in
5. SWAYAM – https://swayam.gov.in
6. National Digital Library of India (NDLI) - – https://ndl.iitkgp.ac.in

TECHNICAL SKILLS

TESTING AND SERVICING OF ELECTRONIC COMPONENTS

COURSE CODE: 24UPH381
CONTACT HOURS: 02 **CREDITS: 02**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

COURSE OUTCOMES:

CO No.	Upon completion of this course, the students will be able to	Cognitive Level
CO1	Identify basic electronic components and their functions in circuits	K1
CO2	Explain the working principles of electronic components and instruments	K2
CO3	Apply tools and instruments to measure electrical parameters and test devices	K3
CO4	Analyze faults in electronic circuits and perform troubleshooting	K4
CO5	Demonstrate soldering, de-soldering, and servicing of electronic systems	K3

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Syllabus

1. Identification and analysis of faults in electronic circuits
2. Study of grounding systems and safety precautions in electronic equipment
3. Identification of resistors and measurement using colour code and multimeter
4. Study and measurement of capacitors and inductors
5. Study of transformer and switch mode power supply operation
6. Construction and analysis of Zener diode as a voltage regulator
7. Practice of soldering techniques for electronic components
8. Study and application of de-soldering techniques
9. Measurement of electrical parameters using analog and digital multimeters
10. Study and measurement of signals using CRO
11. Testing and troubleshooting of LED/LCD TV power supply board
12. Testing and analysis of LED TV display and remote control functionality

Text Books

1. V. K. Mehta and Rohit Mehta, Principles of Electronics, S. Chand Publishing, New Delhi.
2. S. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, McGraw Hill Education, New Delhi.

Web Resources

1. **https://www.allaboutcircuits.com**
2. **https://www.electronics-tutorials.ws**
3. **https://www.electronicshub.org**

4. **https://www.electronicsforu.com**

UP SKILLING

COURSE CODE: 24UCA711
TOTAL MARKS: 100 **CREDITS: 4**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

Course Description

This course enables students to develop domain-specific innovative skills aligned with their entrepreneurial aspirations. It focuses on translating identified problems / gaps into validated concepts through technical skill acquisition, tool training, ideation processes, feasibility analysis, and structured innovation frameworks. The course prepares students to identify problems, validate solutions, undergo skill development programmes, participate in boot camp, industrial training and certification, and perform tool validation.

Course Objectives

After completion of this course, graduates will be able to:

1. **Apply (K3)** domain-specific tools and techniques relevant to entrepreneurship.
2. **Analyze (K4)** the feasibility and practicality of proposed concepts using appropriate frameworks.
3. **Evaluate (K5)** the technical, professional, and market viability of innovative ideas.
4. **Design (K6)** validated concept notes, prototypes, or competency frameworks.
5. **Demonstrate (K6)** acquired skills through certification, tool usage, internship application, or innovation outputs.

Course Expected Learning Outcomes

COs	Course Expected Learning Outcome	RBT (KL)
CO1	Apply relevant domain-specific tools and techniques	K3 – Apply
CO2	Analyze feasibility and innovation potential	K4 – Analyze
CO3	Evaluate technical/professional/market viability	K5 – Evaluate
CO4	Design validated innovative concepts or competency models	K6 – Create

INCUBATION

COURSE CODE: 24UCA757
TOTAL MARKS: 100 **CREDITS: 2**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**
Course Description

This course enables students to design, develop, and validate product/application aligned with their entrepreneurial aspirations. It emphasizes translating identified PROBLEM into functional application prototypes/ digital solutions/ process models/ creative content or competency frameworks using structured innovation methods, and feasibility analysis.

Students' progress from ideation to product development

Course Objectives: After completion of this course, graduates will be able to:

1. **Apply (K3)** domain-relevant development tools, software platforms, or technical frameworks.
2. **Analyze (K4)** application feasibility, usability, and operational practicality.
3. **Evaluate (K5)** technical robustness, industry relevance, and market viability.
4. **Design (K6)** validated application prototypes or structured solution models.
5. **Demonstrate (K6)** discipline-specific application competency by developing, testing, and presenting functional prototypes or applied solution models using skills acquired in the Innovative Skill course.

Course Expected Learning Outcomes

CO	Course Expected Learning Outcome	RBT (KL)
CO1	Apply development tools/platforms relevant to aspiration pathway	K3
CO2	Analyze feasibility and user relevance of applications	K4
CO3	Evaluate technical, operational, and market viability	K5
CO4	Design and demonstrate validated discipline-specific applications using previously acquired innovative skills	K6

START-UP

COURSE CODE: 24UCA712
TOTAL MARKS: 100 **CREDITS: 4**
INTERNAL MARKS: 40 **EXTERNAL MARKS: 60**

Course Description

This course enables students to commercialize developed products/services, execute marketing strategies, and establish startups through company registration and enterprise launch. It emphasizes real-time business execution, customer validation, branding, and financial planning.

Students' progress from product readiness to market entry and enterprise formation.

Course Objectives

After completion of this course, graduates will be able to:

1. **Apply (K3)** marketing tools, digital platforms, and business strategies for product commercialization.
2. **Analyse (K4)** market conditions, customer segments, and competitive landscape.
3. **Evaluate (K5)** financial feasibility, sustainability, and legal requirements of startups.
4. **Design (K6)** business models, branding strategies, and go-to-market plans.
5. **Demonstrate (K6)** entrepreneurial competency by launching a startup, registering a company, or implementing a revenue-generating model.

Course Expected Learning Outcomes

CO	Course Expected Learning Outcome	RBT (KL)
CO1	Apply marketing tools and business strategies for commercialization	K3
CO2	Analyze market demand, customer needs, and competition	K4
CO3	Evaluate financial, legal, and operational feasibility of startup	K5
CO4	Design and demonstrate startup launch, branding, and business model implementation	K6