1.1.3

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Employability Contents	**Green**	
Entrepreneurship Contents	**Light Blue**	
Skill Development Contents	**Pink**	
Name of the Subjects/Related to all three Components (Employability/ Entrepreneurship/ Skill Development)	**Yellow**	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Pure and applied physics*

Programme Name : *Bachelor* of Science in Physics

Academic Year : 2021-22

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	PPUATT2	Mechanics
02.	SECPP01	Analytical Techniques in Physic
03.	SECPP01	Analytical Techniques in Physics Lab
04.	SECPP02	Renewable Energy and Energy Harvesting
05.	PPUBTT2	Waves and Optics

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Dept. of Pure & Applied Physics
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Scheme and Syllabus

Sem.	Course	Course Code	Course Name	Credits	Credits (L+T+P)	Internal Marks/	ESE Max. Marks	Total Marks
I	Core 1	PPUATT1	Mathematical Physics-I	5	4+1+0	30	70	100
	Core 2	PPUATT2	Mechanics	3	3+0+0	30	70	100
		PPUALT2	Mechanics Lab	2	0+0+2	30	70	100
	GE-1		Opted from the pool Course and offered by Sister Departments	5		30	70	100
	AEC-1		Opted from the Pool Course offered by University	2		30	70	100
	SEC-1		Opted from the Pool Course offered by University	2		30	70	100
			Total	**19**				**600**
II	Core 3	PPUBTT1	Electricity and Magnetism	3	3+0+0	30	70	100
		PPUBLT1	Electricity and Magnetism Lab	2	0+0+2	30	70	100
	Core 4	PPUBTT2	Waves and Optics	3	3+0+0	30	70	100
		PPUBLT2	Waves and Optics Lab	2	0+0+2	30	70	100
	GE-2		Opted from the pool Course and offered by Sister Departments	5		30	70	100
	AEC-2		Opted from the Pool Course offered by University	2		30	70	100
	SEC 2		Opted from the Pool Course offered by University	2		30	70	100
			Total	**19**				**600**
III	Core 5	PPUCTT1	Mathematical Physics-II	5	4+1+0	30	70	100
	Core 6	PPUCTT2	Thermal Physics	3	3+0+0	30	70	100
		PPUCLT2	Thermal Physics Lab	2	0+0+2	30	70	100
		PPUCTT3	Analog Systems and Applications	3	3+0+0	30	70	100

	Core 7	PPUCLT3	Analog Systems & Applications Lab	2	0+0+2	30	70	100
	GE-3		Opted from the pool Course and offered by Sister Departments	5		30	70	100
	AEC-3		Opted from the Pool Course offered by University	2		30	70	100
	Additional Credit Courses					30	70	100
			Total	**22**				**800**
IV	Core 8	PPUDTT1	Mathematical Physics-III	5	4+1+0	30	70	100
	Core 9	PPUDTT2	Elements of Modern Physics	3	3+0+0	30	70	100
		PPUDLT2	Elements of Modern Physics Lab	2	0+0+2	30	70	100
	Core 10	PPUDTT3	Digital Systems and Applications	3	3+0+0	30	70	100
		PPUDLT3	Digital Systems and Applications Lab	2	0+0+2	30	70	100
	GE 4		Opted from the pool Course and offered by Sister Departments	5		30	70	100
	AEC -4		Opted from the Pool Course offered by University	2		30	70	100
	Internship*			6**		30	70	100
	Additional Credit Course					30	70	100
			Total	**22+6****				**900**
V	Core 11	PPUETT1	Quantum Mechanics & Applications	5	4+1+0	30	70	100
	Core 12	PPUETT2	Statistical Mechanics	5	4+1+0	30	70	100
	DSE - 1	PPUETD1	Fundamentals of Nano Materials	3	3+0+0	30	70	100
		PPUELD1	Basic Nano Materials Lab	2	0+0+2	30	70	100

	DSE - 2	PPUETD2	Experimental Techniques	3	3+0+0	30	70	100
		PPUELD3	Experimental Techniques Lab	2	0+0+2	30	70	100
	AEC-5		Opted from the Pool Course offered by University	2		30	70	100
	Additional Credit Courses					30	70	100
			Total	**22**				**800**
VI	Core 13	PPUFTT1	Electromagnetic Theory	5	4+1+0	30	70	100
	Core 14	PPUFTT2	Solid State Physics	3	3+0+0	30	70	100
		PPUFLT2	Solid State Physics Lab	2	0+0+2	30	70	100
	DSE 3	PPUFTD1	Basics Nuclear Physics	3	3+0+0	30	70	100
		PPUFLD2	Basics Nuclear Physics Lab	2	0+0+2	30	70	100
	Seminar	PPUFS01#	Seminar	2		30	70	100
	Dissertation	PPUFD01#	Dissertation/ project work followed by seminar	7		30	70	100
			Total	**23**				**600**
Ability Enhancement Course (AEC) offered by Department								
1	AEC	AECPP01	Indian Contribution to Physics	2	2+0+0	30	70	100
2	AEC	AECPP02	Physics for Sustainable Future	2	2+0+0	30	70	100
Skill Enhancement Course offered by Department								
1	SEC	SECPP01	Analytical Techniques in Physics	2	1+0+1	30	70	100
2	SEC	SECPP02	Renewable Energy and Energy harvesting	2	1+0+1	30	70	100
Generic Elective offered by Department								
1	GE	PPUATG1	Mechanics	3	3+0+0	30	70	100
		PPUALG1	Mechanics Lab	2	0+0+2	30	70	100
2	GE	PPUBTG2	Electricity and Magnetism	3	3+0+0	30	70	100
		PPUBLG2	Electricity and Magnetism Lab	2	0+0+2	30	70	100

3	GE	PPUCTG3	Thermal Physics	3	3+0+0	30	70	100
		PPUCLG3	Thermal Physics Lab	2	0+0+2	30	70	100
4	GE	PPUDTG4	Elements of Modern Physics	3	03+0+0	30	70	100
		PPUDLG4	Elements of Modern Physics Lab	2	0+0+2	30	70	100

#The Code generated by the Department.

PHY- Physics, T- Theory, P- Practical, S- Seminars

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1.

Semester - I

Core - 2: Mechanics **Credits = 3 (3+0+0)**

Course Code: PPUATT2

Course Objectives

- This course would empower the student to acquire theoretical concept and practical knowledge regarding mechanical motions. This syllabus will cater the basic requirements for their higher studies. This course will provide a theoretical basis for doing experiments in related areas

Learning Outcomes

- Upon successful completion of this course, students will be able to understand basic concept about Newtonian mechanics and Special theory of relativity, which is very fundamental for further higher studies in physics.

Unit – I: Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket.Motion of a projectile in uniform gravitational field Dynamics of a system of particles.Centre of Mass. Principle of conservation of momentum.
Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces.PotentialEnergy.Energy diagram.Stable and unstable equilibrium.Elastic potential energy. Force as gradient of potential energy. Work & Potential energy.Work done by non-conservative forces.Law of conservation of Energy
Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Unit – II: Rotational Dynamics: Angular momentum of a particle and system of particles. Torque.Principle of conservation of angular momentum.Rotation about a fixed axis.Moment of Inertia.Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.Kinetic energy of rotation.Motion involving both translation and rotation. **Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube**.**

Unit – III: Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy.Inertial and gravitational mass.Potential and field due to spherical shell and solid sphere.Motion of a particle under a central force field.Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler'sLaws.Satellite in circular orbit and applications.
Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.Coriolis force and its applications

Unit – IV: Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity.Lorentz Transformations.Simultaneity and order of events.Lorentz contraction.Time dilation.Relativistic transformation of velocity, Variation of mass with velocity. Mass-energy Equivalence (only problems)

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.

2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Additional References:
9. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
10. University Physics. F.W Sears, M.WZemansky, H.D Young 13/e, 1986, Addison Wesley
11. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
12. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

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SEC -1: Analytical Techniques in Physics **Credits = 1 (1+0+0)**

Course Code: SECPP01

Course Objective

- The course focuses on the properties, functions of the internal structure, and arrangement of atoms in a crystalline material. It offers an insight into how x-ray diffraction, can solve crystallographic issues related to single and poly-crystalline material, right from the base. This course will also cover the basic principles and techniques of scanning electron microscopy and Atomic Force microscopies along with demonstrations on the instrument details and imaging experiments. The sample preparation techniques for the microstructural analysis and surface Morphology analysis will be discussed. Structural studies by Fourier transform IR (FTIR) and Raman spectroscopies will be discussed.

Course learning outcomes:

- Students will have achieved the ability to: 1. apply appropriate characterization techniques for microstructure examination at different magnification level and use them to understand the microstructure of various materials 3. Determine crystal structure of specimen and estimate its crystallite size by X-ray Diffraction technique 4. Use appropriate spectroscopic technique to measure vibrational / electronic transitions.

Unit – I: Structure and Microstructure analysis by X-ray and electron diffraction: The geometry of crystals and reciprocal lattice, Basics of x-rays and their production and detection, X-ray diffraction, Determination of crystal structure: Qualitative and quantitative analysis, Particle size determination by x-rays, X-rays and stress analysis,

Unit – II: Scanning electron microscopy techniques and Composition analysis by Energy dispersive X-ray (EDX): Introduction to Scanning electron microscopy, Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast,Instrumental details and image formation, Energy-dispersive x-ray spectroscopy (paired with scanning electron microscopy) analysis to gain elemental information about samples.

Unit – III: Structural studies by Fourier transform IR (FTIR) and Raman spectroscopies: Basics of Fourier Transform Infrared (FT-IR) spectrometry,Different regions in infrared radiations, Modes of vibrations in diatomic molecule. characteristic absorption bands, Instrumental details, Qualitative treatment of Rotational Raman effect, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, Instrumental details& data accusation process.

Unit – IV: Ultra-violet and Visible Absorption Spectroscopy: Principle of UV Spectroscopy, Beer's Law and Quantitation, Deviations and limitations to Beer's Law, Instrumentation for UV-VIS spectroscopy i) Components and design ii) Actual commercial instruments, Methods and applications of absorption spectroscopy

Reference Books:

1. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, (2008).
2. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).
3. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, (2001).

SEC -1: Analytical Techniques in Physics Lab **Credits = 1 (0+0+1)**

Course Code: SECPP01

1. Study X-ray diffraction for the purpose of (a) identifying (cubic) crystal systems, (b) determining the lattice constant, a,
2. Study scanning electron microscopy (SEM) technique to obtain real space atomic resolution images of conductive surfaces, Energy-dispersive x-ray spectroscopy (paired with scanning electron microscopy) analysis to gain elemental information about samples.
3. Observation and analysis of a given Spectra to understand IR & Raman spectroscopy. .
4. StudyUltra-violet and Visible Absorption Spectroscopy for finding the bandgap of a given sample. (Only Data Analysis)

Ability Enhancement Course (AEC) offered by Department for the Pool AEC courses of the University

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Skill Enhancement Course (SEC) offered by Department for the Pool SEC courses of the University

SEC : Renewable Energy and Energy Harvesting **Credits = 2 (2+0+0)**

Course Code: SECPP02

Course Outcomes:

- To understand the Energy policies and to know some of the renewable energy sources such as solar energy, off-shore wind energy, tidal energy, biogas energy and hydroelectricity.
- Illustrate Photovoltaic conversion mechanism.
- Appraise wind energy conversion and ocean energy
- Conversion of vibration into voltage using piezoelectric materials,
- Conversion of thermal energy into voltage using thermoelectric modules.
- The students are expected to learn not only the theories of the renewable sources of energy, but also to have hands-on experiences on them wherever possible.

Unit – I: Introduction to Energy Policy:

Overview of world energy scenario; Energy Demand- present and future energy requirements; Review of conventional energy resources, Global warming; Green House Gas emissions, impacts, mitigation; sustainability; Clean Development Mechanism (CDM); Prototype Carbon Fund (PCF). Need and characteristics of photovoltaic (PV) systems, PV modules and sun tracking systems (6)

Unit – II: Renewable Energy Sources & Instruments: Solar, wind, small hydro, biomass, geothermal and ocean energy, energy flow in ecosystem, Solar Energy Resources, Solar radiation: Spectrum of EM radiation, sun structure and characteristics.
Sunshine recorder, Pyranometer, Pyrheliometer, Albedometer, Radiation measurement stations, solar radiation data. (8)

Unit – III: Photovoltaic Materials and Devices:

Bulk and thin film forms of materials, single crystal and polycrystalline, amorphous and nano-crystalline semiconductor materials, Intrinsic, extrinsic and compound semiconductor, Electrical and optical properties of photovoltaic / semiconductor materials, p-n junction: homo and hetero junctions; solar cell design, Dark and illumination characteristics; Principle of photovoltaic conversion of solar energy, various parameters of solar cell. (8)

Unit – IV: Solar Thermal Conversion:

Solar radiation, its measurements and prediction; Solar thermal collectors- flat plate collectors, concentrating collectors; solar heating of buildings; solar still; solar water heaters; solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems.
Introduction to Geothermal Energy, Hydro Energy and Piezoelectric Energy harvesting (8)

Reference Books

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford
5. University Press, in association with The Open University. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009

6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. on- conventional energy resources, B H Khan, Tata McGraw-Hill Publication 2006, ISBN 0-07-060654-42
8. Renewable Energy Resources Paperback John Twidell and Tony Weir ,Routledge, Taylor& Francis, 2015
9. Solar Photovoltaic's: Fundamentals, Technologies And Applications, CHETAN SINGH SOLANKI, PHI Learning Pvt. Ltd., Third Edition 2015
10. Non – Conventional Energy Resources: G. D. Rai, KhannaPublishers,2008.
11. Solar Energy Fundamentals, Technology, and Systems, Klaus JägerOlindoIsabella Arno H.M. SmetsRenéA.C.M.M. van SwaaijMiroZeman Delft University of Technology, 2014

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Core - 4: Waves and Optics **Credits = 3 (3+0+0)**

Course Code: PPUBTT2

Course Objectives:
The course aims to develop an understanding of:
- The type of waves and various phenomenon of optics.
- The superposition of waves, progressive and stationary waves, optical phenomenon based on superposition of waves such as Interference and Diffraction.

Learning Outcomes:
Upon successful completion of this course, students will be able to address following points:
- The physics behind various phenomenon in wave and optics.
- The significance of superposition of waves and optical phenomenon based on principle of superposition of waves.

Unit – I: Superposition of Harmonic oscillations:
Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.
Superposition of two perpendicular Harmonic Oscillations, Graphical and Analytical Methods of Lissajous Figures with equal and unequal frequency and their uses.

Unit – II: Wave Motion and Velocity:
Plane Wave. Longitudinal and Transverse Waves. Plane Progressive (Traveling) Waves. Wave Equation. Particle and Wave Velocities. Group Velocity, Graphical Relation between Wave and Group Velocity, Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.
Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Unit – III: Interference:
Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. (9 Lectures)

Unit – IV: Fraunhofer and Fresnel Diffraction:
Fraunhofer Diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.
Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Reference Books:
1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.