

THE GANDHIGRAM RURAL INSTITUTE (DEEMED TO BE UNIVERSITY)

SYLLABUS FOR

B.Sc. PHYSICS

(For the batches joining in 2021-2022 and afterwards)

Department of Physics

The Gandhigram Rural Institute-Deemed to be University

Gandhigram – 624 302

Dindigul District

Tamil Nadu

India

Name of the Programme	B.Sc Physics										
Year of Introduction	1976				Year of Revision				2021		
Semester-wise Courses and Credit distribution	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
No. of Courses	8	9	12	8	7	7					51
No. of Credits	20	22	24	24	21	21					132

THE GANDHIGRAM RURAL INSTITUTE – DEEMED TO BE UNIVERSITY B.Sc. Physics Programme – Choice Based Credit System (CBCS) (2021-2022) and afterwards						
Sl.No.	Semester	Course Code	Course Title	Nature (Major/ Allied/ Elective/..)	No. of Credits	No. of Hours
1	I	21TAMU0101/ 21HIDU0101/ 21MALU0101/ 21FREU0101	Tamil/Hindi/ Malayalam/French	Language I	3	3
		21ENGU 01X1	English	Language II	3	3
		21NSSU0001/ 21FATU0001/ 21SPOU0001	NSS/ Fine Arts/Sports	Foundation Course	1	-
		21PEYU0001	Yoga	Foundation Course	1	-
		21EVSU0001	Environmental Science	Environmental Science	3+1	-
		21PHYU0101	Mechanics & Properties of Matter	Core Course	3	3
		21PHYU0102**	Practical – I	Core Course	1	3
		21MATU01A1	Allied Mathematics I		4	3
		Total				
2	II	21TAMU0202/ 21HIDU0202/ 21MALU0202/ 21FREU0202	Tamil/Hindi/ Malayalam/French	Language I	3	3
		21ENGU02X2	English	Language II	3	3
		21CTAU0001/ 21CHIU0001/ 21CMAU001	Core Tamil / Core Hindi/ Core Malayalam	Language -III	2	3
		21GTPU0001	Gandhi's Life, Thought and Work	Foundation Course	2	2
		21EXNU0001	Extension Education	Foundation Course	2	-
		21ENGU00C1	Communication and Soft Skills	Soft Skills	2	-
		21PHYU0203	Optics	Core Course	3	3
		21PHYU0204	Practical – II		1	3
		21MATU02A2	Allied Mathematics -II	Allied Course	4	3
Total					22	

3	III	21TAMU0303/ 21HIDU0303 / 21MALU0303/ 21FREU0303	Tamil/Hindi/ Malayalam/French	Language I	3	3
		21ENGU03X3	English	Language II	3	3
		21CTAU0002/ 21CHIU0002	Core Tamil/ Core Hindi	Language III	2	3
		21SHSU0001	ShanthiSena	Part V	1	2
		21CSAU03C1	Introduction to Computer and Programming in C	Computer Skill	3	3
			C practical	Computer Skill	1	2
		21PHYU0305	Thermal Physics	Core Course	3	3
		21PHYU0306**	Practical – III		1	3
		21CHEU03A1	Allied Chemistry I	Allied Course	3	3
		21CHEU03A2	Allied Chemistry - Practical I		1	3
		21PHYU03F1	Extension and Field Visit		1	2
		21EXNU03V1	Village Placement Programme	VPP	2	-
		Total			24	
4	IV	21PHYU0407	Analog and Digital Electronics	Core Course	4	3
		21PHYU0408	Atomic Physics and Lasers		4	3
		21PHYU0409	Mathematical Physics		3	3
		21PHYU0410	Practical – IV		2	6
		21CHEU04A3	Allied Chemistry II	Allied Course	3	3
		21CHEU04A4	Allied Chemistry - Practical II		1	3
		21PHYU04EX	Discipline Centric Elective I	Discipline Centric Elective	3	3
		Generic elective I	Generic elective	3	3	
		21PHYU03F1	Extension and Field Visit	Compulsory Non Credit Course	-	-
	21PHYU04HE	Human ethics		1		
Total			24			
5	V	21PHYU0511	Electromagnetics	Core Course	4	3
		21PHYU0512	Nuclear and Particle Physics/		3	3
		21PHYU0513	Classical Mechanics & Relativity/		4	3
		21PHYU0514**	Practical – V**		2	6
	21PHYU05EX	Discipline Centric Elective II	Discipline Centric Elective	3	3	
		Generic elective II	Generic elective	3	3	
	21PHYU05S1		Skill Based Elective	2	2	
Total			21			
6	VI	21PHYU0615	Solid State Physics	Core Course	3	3
		21PHYU0616	Quantum Mechanics		4	3
		21PHYU0617	Spectroscopy		4	3
		21PHYU0621	Practical - VI		2	6
			Project			

	21PHYU0619	(CFA 40 + External 40 + Viva 20)		0 + 4	-
	21PHYU06MX 21PHYU06MX	Modular Course I Modular Course II	Generic elective SRS (Any 2 Modules)	2 2	
Total				21	
Grand Total				132	

List of Discipline Centric Elective(at least three to be provided)

21PHYU04D1	Solar Thermal & Renewable Energy Systems
21PHYU04D2	Introduction to Astrophysics
21PHYU04D3	Waves and Oscillations

List of Discipline Centric Elective (at least three to be provided)

21PHYU05D4	Instrumentation
21PHYU05D5	Television Transmission & Receiver
21PHYU05D6	Micro Processor 8085 Programming

Skill Based Elective

21PHYU05S1	Instruments and Servicing
21PHYU05S2	Applied Optics
21PHYU05S3	Weather Forecasting

List of Generic elective (at least three to be provided)

21PHYU04G1	Solar Thermal & Renewable Energy Systems
21PHYU04G2	Physics of Sports
21PHYU04G3	Physics of Music

List of Generic elective (at least three to be provided)

21PHYU05G4	Instruments & Servicing
21PHYU05G5	Agricultural Physics
21PHYU05G6	Numerical Methods

List of modular courses (at least four to be provided)

21PHYU06M1	Statistical Mechanics
21PHYU06M2	Electric Circuit Analysis
21PHYU06M3	Optic Communication
21PHYU06M4	Radiation safety
21PHYU06M5	Photovoltaics

Courses offered to the other Departments:

21PHYU01A1 / 21PHYU03A1	Allied Physics – I (Allied Physics for B.Sc., Mathematics and Chemistry Major)
21PHYU02A1 / 21PHYU04A1	Allied Physics – II (Allied Physics for B.Sc., Mathematics and Chemistry Major)

Value Added Courses

21PHYUVAC1	Solar PV Panel Installation and Maintenance
21PHYUVAC2	Non-Destructive Testing
21PHYUVAC3	Electrical Wiring and Trouble Shooting
21PHYUVAC4	Renewable Energy Physics

Semester	First	Course Code	21PHYU0101
Course Title	Mechanics and Properties of Matter		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>To impart knowledge about linear and rotational motion of bodies and gravitational forces among bodies.</p> <p>To make them understand the principles and methods of finding the bulk properties of structural materials.</p>		
UNIT	Content		No. of Hours
I	UNIT – I: Impulse and Linear momentum – series of collisions – elastic collisions and inelastic collisions in one dimension – collision in two dimension – reactions and decay processes – Angular quantities as vectors – rotation with constant angular acceleration - linear and angular, variables – Kinetic energy of rotation – torque – Newton’s second law – Newton’s second law for rotation – work, power and the work – Kinetic energy theorem - angular momentum and its conservation.		10
II	UNIT – II : Newton’s laws of gravitation and principle of superposition – gravitation near the earth’s surface – gravitation inside the earth – gravitational potential energy – planets		10
III	UNIT III: Bending of beams – bending moments – Cantilever: loaded at the free end when the beam weight is ineffective – depression of a beam supported at the ends: loaded cylindrical wire – torsional pendulum – Searle’s method for the comparison of young’s modulus and coefficient of rigidity modulus – columns, pillars and struts.		9

IV	UNIT-IV: Streamlines and equation of continuity – Bernoulli's equation: proof and applications – Velocity of efflux of liquid – Toricelli's theorem , Vena contractor, Venturimeter and pitot tube - Properties of Surface tension, Surface Tension by drop weight method and Capillary rise method – Applications.	10
V	UNIT-V: Viscosity – Coefficient of viscosity – critical velocity – Reynolds number and its significance – Poiseuille's equation – experimental determination of viscosity : Poiseuille's method, Stokes method, Ostwald's viscometer, Rankine's method for air – Diffusion and osmosis – basic ideas.	9
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: Specify the principles and types of collision between the bodies.</p> <p>CO2: State the Newton's second law and conservation of Angular momentum.</p> <p>CO3: Estimate the gravitational force near and inside the earth surface and the energy of satellites</p> <p>CO4: Design experiments to find the Young's modulus and rigidity modulus of building materials.</p> <p>CO5: Discuss the principle of flow of liquids and its applications in daily life.</p>	
Reference	<p>1. Fundamentals of Physics – VII Edn. David Halliday, Robert Resnick and Krane – Asian Books, New Delhi (1994) Unit I : Relevant section of Chapter 10, 11 and 12. Unit II : Relevant section of ibid Chapter 15.</p> <p>2. Elements of properties of matter, - D.S. Mathur, Chapter 10, 11 and 12 and chapter 21. Reprinted in 1984, S. Chand & Co., New Delhi. Relevant section of XII & XIII and related problems.</p> <p>3. Concept of physics H.C.Verma, Bharati Bhawan publishers and distributors (2015).</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO								
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO1	3	3	3	-	1	-	2	3	3
CO2	3	3	3	-	2	-	2	3	3
CO3	3	2	3	-	-	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3

Mean = 109/45 = 2.794

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	First	Course Code	21PHYU0102
Course Title	Practical – I		
No. of Credits	1	No. of contact hours per Week	1
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to To familiarize and make the students acquire knowledge and skills through basic Measuring instruments and measurement techniques.		
UNIT	Content		No. of Hours
I	<p>Basic Measurement Techniques, Errors of observation, Data Representation and Analysis</p> <ol style="list-style-type: none"> 1. Vernier calipers & Vernier Microscope 2. Single Optic level & Screw gauge 3. Measurement of length / a dimension using <ol style="list-style-type: none"> a. crude estimation b. un graduated scale c. graduated meter scale d. Vernier caliper e. Vernier microscope f. Screw gauge g. Single optic lever 4. Choice of instrument for measurement <ol style="list-style-type: none"> a. Random Errors in observation b. Due to personal judgment: Period of oscillation of a simple pendulum c. Due to fluctuation in the experimental conditions: resistance measurement at cold water temperature, at a slightly higher and at slightly 		

	<p>lower temperature method of reducing random errors.</p> <p>d. Systematic Errors in observation due to</p> <ol style="list-style-type: none"> 1. Personal judgment : Parallax Error 2. due to the instrument: Zero Error in meters, screw gauge etc. 3. due to backlash Error in Vernier microscope. 4. due to experimental conditions: measurement of resistance at cold water temperature and higher temperature. <p>5. Method of reducing Systematic. Estimation of errors of observation.</p> <p>c. in a single measurement</p> <p>d. in several measurement of the same quantity</p> <ol style="list-style-type: none"> 1. Estimation of standard deviation 2. Effect of the number of readings on standard deviation <p>5. Generation of linear and nonlinear data and graphical representation</p> <ol style="list-style-type: none"> a. Extension of a spring b. Water flowing through a burette or cooling of a hot body. <p>6. Least square fit, arriving at empirical relations from an examination of the graph.</p> <p>7. Study of Motion of a compound pendulum.</p> <ol style="list-style-type: none"> a. Dependence of the period of oscillation on moment of Inertia, amplitude of oscillation, damping (viscous, frictional and electromagnetic) b. Determination of the acceleration due to gravity <p>8. Surface tension – Interfacial tension.</p> <p>9. Coefficient of viscosity.</p>	
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Semester	First	Course Code	21PHYU0203
Course Title	OPTICS		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	50%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p style="text-align: center;">To acquire knowledge on few basic physics optical phenomena and their corresponding theoretical aspects.</p>		
UNIT	Content		No. of Hours
I	<p>GEOMETRICAL OPTICS : Lens–Spherical aberration in lenses–Methods of minimizing spherical aberration – chromatic aberration in lenses condition for achromatism of two thin lenses (in and out of contact) – Coma – Aplanatic lens –Dispersion –Angular and Chromatic dispersion – combination of prisms to produce i) dispersion without deviation ii) deviation without dispersion– Cauchy’s dispersion formula.</p>		12
II	<p style="text-align: center;">INTERFERENCE/INTERFEROMETRY:</p> <p>Analytical treatment interference – theory of interference fringes – interference in thin films due to reflected light – Airwedge – experiment to find thickness of a wire – Testing the planes of surfaces – Newton’s rings– theory and experiment –Michelson’s interferometer – the Fabry–Perot Interferometer – Lummer – Gehrckeplate – Jamins’–Rayleigh’s refractometer and satellites – orbits and energy of satellites.</p>		10
III	<p>DIFFRACTION (Fresnel and Fraunhofer) – Diffraction by single slit and determination of intensity distribution by phasor method – Diffraction by circular aperture– plane transmission grating–diffraction at normal and oblique incidence– Resolving power of a plane diffraction grating and prism – Fresnel wave front and theory of half period zones – zone plate –comparison with convex lens–comparison between Fresnel and fraunhofer diffraction.</p>		10

IV	POLARIZATION : Birefringence, Nicol prism – its construction and theory – Elliptically and circularly polarized light, Theory, Production and analysis; Quarter and half-wave plates. Interference of polarized light; Double refraction, Rotatory polarization; Fresnel’s explanation; Specific rotation; Laurent’s polarimeter, Half Shade device Properties of Surface tension, Surface Tension by drop weight method and Capillary rise method – Applications.	10
V	OPTICAL INSTRUMENTS: Microscopes–Simple Microscope (Magnifying glass) – compound Microscope – UltraMicroscope–Eyepieces–Huygen’sEyepiece– Ramsden’sEyepiese–ComparisonofEyepieces–Telescope– Refracting astronomical telescope –Abbe Refractometer – Ulrich refractometer – Photographic Camera–Prism binoculars.	6
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: Acquire the knowledge of principle of interference CO2: Apply the principle of interference to applications Michelson Interferometer Fabry – Perot Interferometer, Interference filters, Lummer–Gehrcke plate; Jamins’ Interferometer and Rayleigh’s refractometer. CO3: Discuss theory of zone plate and Compare zone plate with convex lens. CO4: Discuss intensity distribution in Fresnel diffraction due to straight edge, narrow obstacle, rectangular aperture, circular aperture and Cornu’s spiral. CO5: Explain the principle of polarization and apply the principle to optical applications.</p>	
Reference	<p><u>Text Books:</u></p> <ol style="list-style-type: none"> 1. Dr.N. Subramaniyam, Brijlal and Dr.M.N. Avathanilu, Optics,S. Chand &Co, Pvt.Ltd.25th revised edition, New Delhi, 2012. <p><u>BOOKS FOR REFERENCE:</u></p> <ol style="list-style-type: none"> 1. Optics – Ajoy Ghatak, 2nd Edition, Tata McGraw Hill Pub. Copy. Ltd., New Delhi, 1992. 2. Introduction to Classical and Modern Optics-J.R. Meyer Arendt-2nd edition-PHI, 1984. 3. Fundamentals of Physics – V Edn. David Halliday, Robert Resnick and K.S.Krane–john Wiley & Sons New Delhi (2014) Relevant section of Chapter-19 	

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	3	1	-	-	-	-	3	3
CO2	3	3	2	2	3	3	2	3	3
CO3	3	3	1	-	-	-	-	3	3
CO4	3	3	3	-	-	2	-	3	3
CO5	3	3	3	2	3	-	-	3	3

$$\text{Mean} = 87 / 45 = 2.718$$

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Second	Course Code	21PHYU0204
Course Title	Practical – II		
No. of Credits	1	No. of contact hours per Week	1
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Practical		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to To expose the measuring skills on the fine apparatus to measure to magnitudes of properties on mechanical and optical areas		
UNIT	Content	No. of Hours	
I	<ol style="list-style-type: none"> 1. Study of depression and deflection of a cantilever <ol style="list-style-type: none"> a. Variation of deflection / depression with distance from fixed end b. Young's modulus 2. Young's modulus – Non uniform bending 3. Young's modulus – Uniform bending 4. Young's modulus – Koenig's method 5. Familiarisation with spectrometer – Refractive Index of solid and liquid. 6. Dispersive power of the material of a prism 7. i-d curve 8. i- i' curve and Stoke's formula 9. Radius of curvature – Newton's rings 10. a. Thickness of a wire – Air wedge b. Wavelength of light – Biprism 		

Semester	Three	Course Code	21PHYU0305
Course Title	Thermal Physics		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>The fundamental concepts on Thermal Physics is being exposed under various angles</p>		
UNIT	Content		No. of Hours
I	UNIT – I : Kinetic theory of gases: Pressure exerted by a perfect gas – rms velocity – deduction of gas laws – distribution of velocities – deduction of Maxwell – Boltzmann law – average velocity – degrees of freedom (other than translational) – law of equipartition of Kinetic energy – mean free path and its expression – transport phenomena: viscosity, thermal conductivity and diffusion.		9
II	UNIT – II : Equation of state for real gases : Van der Waals equation – Critical constants in terms of Van der Waals constants – Reduced equation of states–Law of corresponding states – Joules experiments on inter molecular attraction – Discovery of intermolecular attraction – Porous plug experiment – Linde’s process for liquefaction of air– liquefaction of hydrogen – liquefaction of Helium.		10
III	UNIT – III: First law of thermodynamics: Work – dependence of work on the path - work done in certain processes – internal energy – enthalpy – energy equation – T-V., T-P, P-V independence.		11
IV	UNIT IV: Second law of thermodynamics: Entropy – Calculation of entropy changes in reversible and irreversible processes – Clausius and Kelvin – Planck statement of the second law, Carnot theorem – thermodynamic scale of temperature – steam engine- Rankine cycle		8

V	UNIT – V : Entropy of a perfect gas – T-S diagram – Maxwell’s thermodynamic relations – TdSequations – variation of intrinsic energy with volume – Joule-Kelvin coefficient – thermodynamicfunctions – internal energy – enthalpy – Helmholtz function – Gibbs function.	10
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: Understand the basic kinetic theory of gases and deduce gas laws CO 2: Understand the real gas analysis and arrive at Van der Waal’s equation CO 3: Know the I and II Law of thermodynamics and its applications CO 4: Identify the functioning of the Heat engines and Refrigerator CO 5: Be aware of basic ideas of entropy and thermodynamic functions</p>	
Reference	<p><u>Text Books:</u></p> <p>1. Heat and Thermodynamics by D.S. Mathur, Sultan Chand & Sons Educational publishers, NewDelhi, Fifth Edition Unit I : Chapter 6: 207, 3 25 Unit II: Chapter 7: 268-278; 282-287; Chapter11: 429-433 Unit III: Chapter 8: 305– 315, 316– 323 Unit IV: Chapter 8: 323–328, 334–357 Unit V : Chapter 9: 358–366 & 374–387; Chapter 10: 387–398 & 401–403</p>	
	<p><u>BOOKS FOR REFERENCE:</u></p> <p>1. Heat & Thermodynamics: M.W. Zemansky and R.H. Dittman – International edition. 2. A treatise on heat – Saha and Srivastava, Vth Edition. 3. Thermodynamics, Kinetic theory and Statistical thermodynamics III Edition – Sears and Salinger, Indian student’s edition, Narosa Publications, New Delhi. 4. Fundamentals of Physics – VIIth Edn., - David Holliday, Robert Resnick and Krane 5. Heat and thermodynamics by D.S. Mathur, Sultan Chand, 1978.</p>	

Related online courses – MOOC courses:

1. <https://www.edx.org/course/basics-transport-phenomena-delftx-tp101x-2>
2. <https://www.edx.org/course/thermodynamics-iitbombayx-me209-1x-1>

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO 8	PSO 9
CO 1	-	3	3	-	-	-	-	2	1
CO 2	1	2	3	1	1	1	1	3	1
CO 3	-	2	2	2	2	2	2	3	2
CO 4	-	3	3	3	2	2	2	3	2
CO 5	-	2	3	3	2	-	-	3	2

Mean = 75/ 45 = 2.14

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Third	Course Code	21PHYU0306
Course Title	Practical – III		
No. of Credits	1	No. of contact hours per Week	1
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to To expose the measurement on electricity and advanced measurement on optics areas has been exposed		
UNIT	Content		No. of Hours
I	<ol style="list-style-type: none"> 1. Study of Fraunhofer diffraction at single and double slits. 2. Wavelength of light – Diffraction grating 3. Cauchy's dispersion formula – Cauchy's constants 4. <ol style="list-style-type: none"> a. Verification of Brewster's law b. Study of rotatory power of materials – Laurent's half shade polarimeter. 5. Familiarisation with the use of Voltmeter, Ammeter, Multimeter Voltage divider and current divider arrangements: series and parallel connections. 6. Verification of Kirchoff's laws and Thevenin's theorem. 7. Measurement of resistance and temperature Coefficient of resistance – Carey Foster's bridge 8. Potentiometer – measurement of low voltage – EMF of Thermocouple, calibration of low 		

	<p>range voltmeter</p> <p>9. Potentiometer – measurement of medium and high voltages – calibration of medium and high range voltmeters</p> <p>10. Potentiometer – measurement of current, calibration of ammeter.</p>	
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Semester	Four	Course Code	21PHYU0407
Course Title	Analog and Digital Electronics		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	60%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>The student will be able to design simple electronic circuits for the laboratory and home with the help of knowledge gained through this course.</p>		
UNIT	Content		No. of Hours
I	<p>UNIT – I : DEVICES : Transistor structure – action of a transistor – relation between currents in a transistor – sign conventions – transistor as an amplifier – three configurations: CE, CB & CC-transistor characteristics in CE configuration -relation between alpha and beta-comparison between the three configurations, reasons for the choice of CE configuration – hybrid parameters – simplified model - basic CE amplifier- FET: construction, working and characteristics – small signal model of FET - single stage transistor amplifier- graphical method – ac equivalent circuit - calculation of gain - -amplifier analysis : Calculation of gain, input and output impedances.</p>		13
II	<p>UNIT – II: MULTISTAGE AMPLIFIERS: Gain of a multistage amplifier-decibel-coupling of two stages: direct coupling - RC coupling transformer coupling-frequency response of an RC coupled amplifier- bandwidth of an amplifier. Expression of gain in dB- 3 dB frequencies - FEEDBACK AMPLIFIER: Concept of feedback – types of feedback: voltage series, voltage shunt, current</p>		13

	series and current shunt amplifiers – ideal input and output resistance of the four types of amplifiers - voltage gain with feedback – advantages of negative feedback – Oscillators: positive feedback amplifier as an oscillator- Hartley oscillator and Colpitt's oscillator (no detailed derivation) – how to use them to measure capacitances and inductances	
III	UNIT – III: OPAMP: Difference amplifier and need for the same - General features – Virtual ground –inverting amplifier, non-inverting amplifier- voltage follower – inverting and non-inverting summing amplifier –subtractor-integrator and differentiator – solution of simultaneous equations with two unknowns and harmonic oscillator problem.	13
IV	UNIT – IV: LOGIC CIRCUITS: Universal NAND and NOR gates – combinational logic circuits – Boolean laws and theorems – Boolean relation for OR and AND operations – duality theorem -half and full adders – half and full subtractors – sum of products and product of sum methods – sum of product and product of sum equations – Karnaugh maps – truth table to Karnaugh map – 3 and 4 variable maps – pairs, quads and octets – Karnaugh simplification – overlapping – rolling the map – eliminating redundant graphs – don't care conditions. Examples – AND_OR and OR-AND circuits - Illustrations with full adder and full subtractor circuits.	13
V	UNIT – V: FLIP FLOPS AND COUNTERS: RS flip flops – clocked RS flip flop – D flip flop – edge triggered D flip flop – JK flip flop – JK master slave – Synchronous and asynchronous counters – concept of setup time, hold time and propagation delay - 3 bit binary ripple counter – 3 bit up-down counter – synchronous counter – mod – 8 parallel binary counter – mod 3 counter – mod 5 counter – mod 10 decade counter – shift counters – 3 stage shift registers – mod 10 shift counter – illegal states in shift counters and methods to avoid the problem associated with it.	12

<p>Course Outcomes</p>	<p>On completion of the course, students should be able to do</p> <p>CO 1: will be capable of analyzing and measuring different parameters related to junction transistor and FETs</p> <p>CO 2: will be able to measure the gain, input and output resistance and bandwidth of an amplifier</p> <p>CO 3: will be capable of designing oscillators of desired frequency and use them to estimate capacities and inductances</p> <p>CO 4: will be able to design Op-amp based circuits and implement to simple instruments</p> <p>CO 5: will be aware of methods to reduce logical circuits and implement them</p>
<p>Reference</p>	<p><u>Text Books:</u></p> <p>1. Bhargava NN, Kulshreshta DC and Gupta SC, Basic electronics and linear circuits, Tata McGraw Hill (1984),</p> <p>Unit I: Chapter 5, page 126-161, 168-173, Chapter 8, page 261-278</p> <p>Unit II: Chapter 9, 302-320, Chapter 12, page 390-402 and Chapter 13, page 413-424.</p> <p>2. Jacob Millman, Microelectronics: Digital and Analog Circuits and Systems, McGraw Hill, Singapore (1979).</p> <p>Unit III: Chapter 16, page 569 – 573, 577 - 582</p> <p>Donal P Leach. Albert Paul Malvino and Gautam Saha, Digital principles and applications, Seventh Edition, Mc Graw Hill, New Delhi (1986).</p> <p>Unit IV: Chapter 2, page 48 – 56, Chapter 3, page 74- 101, Chapter 6, page 226 – 228</p> <p>Unit V: Chapter 8, page 270 – 286, 288-289, Chapter 10, page 341 - 346, 349 – 356, 360 -367.</p> <p><u>BOOKS FOR REFERENCE:</u></p> <ol style="list-style-type: none"> 1. Digital Electronics, II Edition, W.H. Gothmann PHI, New Delhi (1991) 2. Digital Fundamentals, 3rd Edition, L.Floyd, Universal Book Stall, New Delhi (1998) 3. Digital Integrated Electronics, Herbert Taub and Donald Schilling, McGraw Hill, International Book Company, 11th Edition (1985)

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	2	-	2	3	-	2	1	2
C02	3	2	-	2	3	-	2	1	2
C03	3	2	-	2	3	-	2	1	2
C04	3	2	-	2	3	-	2	1	2
C05	3	2	-	2	3	-	2	1	2

Mean = 75/ 45 = 2.14

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Four	Course Code	21PHYU0408
Course Title	Atomic Physics and Lasers		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	25%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>The development of Physics concepts are introduced in the order of the development of concepts. Also the advanced level optics utilization principles are introduced in the form of lasers.</p>		
UNIT	Content		No. of Hours
I	UNIT – I: Particle properties of waves: Electromagnetic Waves – Black body radiation – Photoelectric Effect – What is Light – Compton Effect. Waves Properties of Particle: De Broglie waves – waves of Probability – The general formula for waves – Phase and group Velocities – Particle Diffraction.		13
II	UNIT – II: X-rays: Waves nature of X-rays – Diffraction of X-rays by crystals – Bragg’s Law, reflection of X-rays – experimental methods of measuring μ for X-rays- Scattering of X-rays – Polarization of X-rays,		13
III	UNIT – III : Atom Models: Alkali Spectra – Space quantization and normal Zeeman effect – Electron spin – vector model of atom – Doublet structure of the alkali spectral lines – Fine structure of the hydrogen spectral terms – Pauli’s exclusion principle; periodic classification of elements – Arrangement of electrons in atoms – Energy levels of complex atoms – Anomalous Zeeman effect – Paschen – Back effect - Stern and Gerlach’s experiment – Stark effect.		13
IV	UNIT – IV: Lasers: Introduction – The Fiber Laser – The Ruby Laser – The He-Ne Laser – Optical Resonators – Einstein Coefficients and		13

	Optical Amplification – The Line –Shape Function -Typical Parameters for a Ruby laser – Monochromaticity of the Laser Beam	
V	UNIT – V: Fiber Optic communication: Introduction – some historical remarks – Total Internal Reflection – The Optical Fiber – Why Glass Fibers? – The Coherent Bundle – The numerical Aperture – Attenuation in Optical Fibers – Single Mode and Multimode Fibers – Pulse Dispersion in Optical Fibers – Dispersion and Maximum Bit Rates – Waveguide Dispersion – Dispersion Compensating Fibers – Fiber – Optic Sensors.	12
Course Outcomes	On completion of the course, students should be able to do CO 1: will become capable of understanding particle and wave nature and its behavior. CO 2: will be able to understand the wave nature of X-rays. CO 3: will be able to understand the effect of electric and magnetic fields on the molecules and exploration of spectral data. CO4: will be aware of different kinds of laser and its importance. CO 5: will be capable of understanding the principle and various modes of fiber optic communication and its applications.	
Reference	Text Books: 1. Concepts of Modern Physics -Arthur Beiser, Tata McGraw-Hill Publishing Company Limited, Sixth edition. Unit I -page number 53-79 and 93-106. 2. Atomic Physics – J.B.Rajam, S.Chand & Company Ltd.,(2004) Unit II - Page Number: 267- 304 . 3. Atomic Physics (Modern Physics) – S.N.Ghoshal, S.Chand & Company Ltd.,(2004) Unit III: Page Number: 100-141 . 4. Optics, Ajoy Ghatak,– (2005) by Tata Mc Graw-Hill, 2 nd Edition 2005. Unit IV: Chapter 23, Pages 23.3-23.36. Unit V: Chapter 24, Pages 24.3-25.3,	

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	3	3	-	-	2	-	2	3
CO2	3	-	3	-	2	3	1	-	-
CO3	3	3	2	3	3	-	2	-	-
CO4	3	2	3	2	-	1	-	2	-
CO5	2	2	2	2	-	-	2	3	-

Mean = 70 / 29 = 2.41

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fourth	Course Code	21PHYU0409
Course Title	Mathematical Physics		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> Basic Skill / Advanced Skill 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> K-1: (Remember) K-2: (Understand) K-3: (Apply) K-4: (Analyze) K-5: (Evaluate) K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> Provide the physical understanding of mathematical insight about all physical items. Evalu the liquid dynamics and charge properties of matter through the mathematical formulation. The applications of special functions in electro dynamics and electromagnetic 		
UNIT	Content	No. of Hours	
I	Differentiation of vectors – Scalar and vector point functions – gradient, divergence and curl of vector fields – vector integration – line integrals – surface integrals – volume integrals – divergence theorem – Stokes theorem and related problems.	10	
II	Types of matrices – rank of a matrix – inverse of a matrix – eigenvalues and eigenvectors – diagonalisation – characteristic equation and Cayley Hamilton theorem.	9	
III	Second order linear homogeneous differential equations – solution by power series method Partial differential equation – important partial differential equations in Physics relevant problems – solutions by the separation of variables.	10	
IV	Special functions: Bessel functions: generating functions – recurrence relations - Legendre differential equation – Power series solution – Legendre polynomials – generating functions – recurrence relations.	10	
V	The Hermite polynomials – basic equation of motion in mechanics – one dimensional linear harmonic oscillator – the solution of Hermite differential equation	9	

References	<p style="text-align: center;">Text Books</p> <p>Mathematical Physics, H.K.Dass, Fourth revised edition 2003. Unit I : Pages 336-389 Unit II : Pages 196 - 199, 250 – 259 and PP 271 - 277, Unit III : Pages 601 – 604, and 637-664, Unit IV : Pages 548-551, 562 – 573, 581 - 594 Unit V : Pages Pages164-170</p>
	<p style="text-align: center;">Reference Books</p> <ol style="list-style-type: none"> 1. Introduction to Mathematical Physics – Charley Harper – PHI India. 2. Mathematical Physics – P.K. Chattopadhyoy – Wiley Eastern Ltd., 3. Advanced engineering Mathematics – Erwin Kreyzik – Wiley Ltd.
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: To make the students to explore the conceptualisation of the scalar and vectorial functions using different vector operators, through the vector dot and vector cross product.</p> <p>CO 2: To give the students the highly perspective transformation theorems to make them understand the configurational geometry of systems.</p> <p>CO3: To know the matrix methods of diagonalization, finding inverse, and to find the eigenvectors by utilizing Cayley-Hamilton theorem.</p> <p>CO 4:To give knowledge on the basic behaviours of the systems and to understand through first order, second order linear homogenous differential equations and to ease them through partial differential equation via variable separable method.</p> <p>CO 5: To solve the differential equations and obtaining solutions for them in terms of power series method. To learn the concepts of Fourier series and Fourier transforms and its related applications besides gamma and beta functions.</p>

Mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO1	3	3	3	-	1	2	3	3	3
CO2	2	3	3	-	-	2	2	1	2
CO3	2	3	2	-	-	2	3	2	2
CO4	1	3	3	-	-	-	2	3	2
CO5	2	3	3	-	-	-	3	3	2

Mean = 82/ 45= 2.411

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fourth	Course Code	21PHYU0410
Course Title	Practical – IV		
No. of Credits	2	No. of contact hours per Week	6
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • To understand the heat conduction phenomena through some standard experiments. • To evaluate the current sensitivity and voltage sensitivity of voltmeters and ammeters through some experiments . • To understand the AC circuit phenomena of active and passive discrete components. 		
UNIT	Content		No. of Hours
I	<ol style="list-style-type: none"> 1. Measurement of temperature using various principles expansion of solids, liquids and gases, resistance thermocouple-Selection of thermometer for different purposes. 2. Measurement of heat energy-method of mixtures-Specific heat capacity of solids, liquids – Latent heat of fusion of ice and latent heat of vaporization of water – Barton’s correction. 3. Cooling curve for wax / naphthalene – Melting point. 4. Measurement of heat energy – Electrical method – specific heat capacity of solids and liquids-Barton’s correction. 		

	<ol style="list-style-type: none"> 5. Study and Measurement of Calorific value of fuels, - Bomb Calorimeter 6. Thermal conductivity of a good conductor – Lee’s Disc method 7. Thermal conductivity of a good conductor – Forbe’s method 8. Verification of Stefan’s law. 9. Figure of merit of a Table galvanometer 10. Conversion of a galvanometer into an ammeter and voltmeter and their calibration. 11. Figure of merit of a suspended coil galvanometer 12. Suspended coil Galvanometer – <ol style="list-style-type: none"> 1. Measurement of low voltage – emf of Thermocouple. 2. Measurement of current – conversion into milli voltmeter 3. Measurement of resistance 13. Ballistic galvanometer <ol style="list-style-type: none"> 1. Figure merit and measurement of charge 2. Capacitance of a capacitor 3. Self inductance of a coil 4. Mutual inductance between a pair of coils 5. High resistance by leakage 6. Measurement of current and resistance 14. Measurement of time constants of circuits – LR, CR 	
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Semester	Fourth	Course Code	21PHYU04D1/ 21PHYU04N1
Course Title	SOLAR THERMAL AND RENEWABLE ENERGY SYSTEMS.		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Discipline Centric Elective/ Generic Elective		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • It gives basic functionalities of different types of energy systems in everyday life. • It gives a method of designing different types of systems for home and national wide applications. 		
UNIT	Content	No. of Hours	
I	Solar Radiation and its Measurement – Solar constant – Solar Radiation at the Earth’s surface, Solar Radiation Geometry – Measurements and Data. Estimation of average Solar Radiation and Solar radiation on tilted surfaces.	9	
II	Solar Energy Collectors: Physical principles of the conversion of solar radiation into heat – Flat Plate Collector (FPC) – Performance analysis of FPC – concentrating collector (CC) advantages and disadvantages of CC over FPC – selective coatings, photo voltaic cell. Application of Solar Energy : Solar water heating – space heating – space cooling – solar electric power generation – agricultural and industrial process heating – solar distillation – solar pumping - solar furnace – solar cooking.	10	
III	Wind energy : Basic principles of wind energy conversion:	9	

	Nature of the wind – the power in the wind – forces on the blades and thrust on turbines = wind energy conversion (WEC) basic components of wind energy conversion – classification of types of WEC systems – advantage and disadvantage of WECs – Generating systems - schemes for electric generation Generator control - Load control – Energy storage – applications of wind energy.	
IV	Biomass : Introduction – biomass conversion technologies – photosynthesis – biogas generation – factors affecting bio digestion on generation of gas – classification and types of biogas plants – advantages and disadvantages of floating drum plant and fixed dome type plant – materials used for Bio-gas generation – selection of site for Bio gas plant – Digesters design considerations. Methods of maintaining biogas production.	10
V	Geothermal and OTEC: Introduction – nature of geothermal fields – geothermal sources – hydrothermal(Convective resources) basic ideas of vapour dominated systems – liquid dominated systems – advantages and disadvantages of geothermal energy over other energy forms – applications of geothermal energy, OTEC : Introduction – Basic ideas of OTEC – methods of OTEC power generation – open cycle and closed cycle system - Energy from tides – basic principle of Tidal power – components of tidal power – operation methods of utilization of tidal energy.	10
References	Text Books Non-Conventional energy sources – G.D. Rai, Khanna Publishers – Fourth edition (1997)	
	Reference Books 1. Solar energy principles of thermal collection and storage – S.P. Sukhatme, TMC – 1984 2. Renewable energy sources and conversion technology – N.K. Bansal, M. Kleemann and M. Melinn 3. Solar Energy Hand Book – John F. Kreider and F. Kreith, McGraw Hill Book Company, (1981)	
Course Outcomes	On completion of the course, students should be able to do CO 1: Define the solar constant and estimate the solar radiation on earth’s surfaces. CO 2: Describe the different types of wind energy conversion technologies. CO 3: Explain the biomass conversion technologies and its classifications. CO 4: Illustrate the methods of generating energy form Geothermal sources. CO 5: Differentiate an open cycle with a closed cycle OTCE	

	power generation systems.
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Mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO 1	3	2	3	2	1	1	1	1	3
CO 2	3	3	2	3	3	3	3	3	3
CO 3	3	3	2	3	3	3	3	2	3
CO 4	3	2	2	3	3	2	3	2	2
CO 5	3	2	1	2	3	2	2	1	1

Mean = 107/45= 2.377

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fourth	Course Code	21PHYU04D2
Course Title	Introduction to Astrophysics		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	Discipline Centric Elective		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • To get a insight about a milky way galaxy. • To get knowledge about Surface temperatures of the stars through various physical models. 		
UNIT	Content	No. of Hours	
I	Astronomical Instruments: Light and its Properties-The Earth's Atmosphere and the Electromagnetic Radiation-Optical Telescopes-Radio Telescopes-The Hubble Space Telescope(HST)-Astronomical Spectrographs-Photographic Photometry-Photoelectric Photometry-Spectrophotometry-Detectors and Image Processing.	8	
II	Distances of stars: Stellar Magnitude Sequence-Absolute Magnitude and the Distance Modulus-The Bolometric Magnitude-Different Magnitude Standards: The UBV system and six- colour Photometry-Radiometric Magnitudes-The colour-index of a star-Luminosities of Stars- Stellar Parallax (Trigonometric) and the Units of Stellar Distances-Stellar Positions: The Celestial Coordinates-Stellar Motions-The Solar Motion and the Peculiar Velocities of Stars-The Velocity Dispersion-Statistical Parallax-Moving Cluster Parallax.	10	
III	Radio Galaxies: Techniques of Identification of Radio Objects-Structures of Radio Galaxies-Classification of Radio Galaxies and Their Typical Characteristics-Energy Processes in Radio Galaxies-Radio Galaxies in Evolutionary Sequence-	10	

	Some Important Radio Galaxies- Seyfert Galaxies Quasars:The Discovery-Radio Properties-Optical Properties- The Red Shift of Quasars-Active Galactic Nuclei.	
IV	Milky way Galaxy: Rotation of the Galaxy: Differential Rotation-Determination of the Rotation Parameters in the Solar Neighborhood-Radio Observation of the Galaxy at 21-cm Wave Length-The Rotation Curve of the Galaxy: The General Rotation Law-Density Distribution of Gas and Spiral Structure of the Galaxy: Radio and Optical Data-The General Structure of the Galaxy-The Mass of the Galaxy-Magnetic Field in the Galaxy-Cosmic Rays- Continuous Radio Emission in the Galaxy.	10
V	Cosmology: Redshift and the Expansion of the Universe -Matter Density in the Universe and the Deceleration Parameter - The Cosmological Principle - Fundamental Equations of Cosmology - The Current Theories: Some Important Models of the Universe- Observational Tests of Cosmological Models - The Cosmic Microwave Background Radiation.	8
References	Text Books An Introduction to AstroPhysics - Baidyanath Basu,Tanuka Chattopadhyay,sudhindra Nath Biswas, Second Edition(2010), PHI Learning Private Limited. Unit I : Chapter 1 Pages 1to26 Unit II : Chapter 3 Pages 56 to 76 Unit III : Chapter 19 & 20 Pages 506 to 535 Unit IV : Chapter 16 Pages 390 to 426 Unit V : Chapter 21 Pages 536 to 565	
	Reference Books 1. A beginner's guide to the universe - Chaisson, E. and McMillan, S., 1998. Astronomy:. Prentice Hall. 2. Fundamental astronomy - Karttunen, H., Kröger, P., Oja, H., Poutanen, M. and Donner, K.J. eds., 2016. Springer. 3. Astrophysics: stars and galaxies - Abhyankar, Krishna Damodar. Universities Press, 2002. 4. Mathematical cosmology and extragalactic astronomy. Segal, Irving Ezra.Vol. 68. Academic Press, 1976. 5. James Binney – Astrophysics a very short introduction – Oxford university press 6. Extragalactic astronomy and Cosmology – An introduction. Peter Schneider, Springer 7. An introduction to modern astrophysics.Carroll, Bradley W., and Dale A. Ostlie. Cambridge University Press, 2017.	

Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: To help gaining knowledge on the stellar atmosphere through various sections and constituents.</p> <p>CO 2: To study the Surface temperatures of the stars through various physical models and hence to classify various stars.</p> <p>CO 3: To make the students understand, the internal structures of the stars through various equilibrium conditions suggested by various theoretical models.</p> <p>CO 4: To study the Milky Way galaxy presence and their properties through various theoretical information.</p> <p>CO 5: To find the status of the universe through various theoretical models and to understand the status of the universe in the past, in the present and in the future.</p>
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Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	1	2
CO2	3	-	-	1	-	-	2	1	2
CO3	3	-	-	-	-	-	2	1	2
CO4	3	-	-	-	-	-	2	1	2
CO5	3	-	-	-	-	-	2	1	2

Mean = 34/20=1.7

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fourth	Course Code	21PHYU04D3
Course Title	Waves and Oscillations		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	5%
Category	Discipline Centric Elective - I		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • To impart knowledge about waves and oscillations and sound. <ul style="list-style-type: none"> ○ To understand the principles and methods of finding the properties. 		
UNIT	Content		No. of Hours
I	Simple Harmonic Motion, Characteristics of S.H.M., Differential equation of S.H.M., K.E., P.E. and Total Energy of a vibrating particle, Energy of Vibration, Oscillations with one degree of freedom, Linearity and superposition principle, Simple pendulum, Compound pendulum, Bar pendulum, LC Circuit, Lissajous figures, Composition of two SHM(s) of frequency ratio 2:1, Experimental methods for obtaining Lissajous figures, Uses of Lissajous figures		10
II	Free, Forced and Resonant Vibrations: Free Vibrations, Undamped Vibrations, Damped Vibrations, Damped S.H.M. in an electrical circuit, Forced Vibrations, Resonance and Sharpness of Resonance, Phase of Resonance, Quality Factor, Examples of Forced and Resonant Vibrations.		9
III	Wave motion, Characteristics of wave motion, Transverse wave, motion, Longitudinal wave motion, Differential equation of wave motion, Particle velocity, Wave velocity, Principle of superposition, Interference of Sound waves, Quicke's tube Seebeck's tube, Beats, Decibel, Doppler effect, Applications.		10

IV	Reflection of Sound, Reflection of a plane wave at plane surface, Experimental determination of reflection of sound, Whispering Galleries, Echo, Applications, Refraction of plane wavefront at plane surface, Experimental demonstration of refraction of sound, Diffraction of sound, Fresnel's Assumptions, Intensity of sound at a point due to plane wavefront, Doppler effect, Applications.	9
V	Ultrasonics, Production of ultrasonics by magnetostriction and piezoelectric methods, detection of ultrasonic waves, Acoustic grating, Applications of ultrasonic waves.	10
References	Text Books Brijlal & Subramanyam "Waves & Oscillations", S.Chand & Co., 1974, Unit I : Pages: 1-30, 37-38, 45, 56-63 Unit II : Pages: 65-83 Unit III : Pages: 82-88, 92-93, 135-141, 211 to 220 Unit IV : Pages: 192-198, 202-209 Unit V : Pages: 282-293	
	Reference Books 1. Sound, M.Narayanamurti, N.Gosakan and T.Rajagopalan, The National Publishing Co, Madras, First Edition, 1978. 2. A Textbook of Sound with Theory of Oscillation and Waves, D.R.Khanna and R.S.Bedi, Atma Ram & Sons, Delhi, 1984	
Course Outcomes	On completion of the course, students should be able to do CO1: Understand the concept of SHM CO2: Explain the free forced and damped vibration CO3: Acquire the knowledge of wave motion CO4: Know the properties of sound CO5: Apply the knowledge to ultrasonic services.	

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	3	2	-	2	2	3	2	3
CO2	3	3	3	-	2	2	2	3	3
CO3	3	3	3	1	3	2	2	3	3
CO4	3	3	3	2	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3

Mean = 115/43 = 2.67

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fourth	Course Code	21PHYU04G2
Course Title	Physics of Sports		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	Generic Elective - I		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development • Employability 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • To Identify the distribution of mass in human body • To describe the velocity, speed and acceleration during running. 		
UNIT	Content		No. of Hours
I	INTRODUCTION: Distribution of mass in Human body – forces in muscles and bones – elastic properties – work, energy and power of the body – sizes – strength and food requirements – calculation of calorific content needed for each sports person.		9
II	RUNNING AND JUMPING: Basic ideas about distance – velocity and speed – acceleration, acceleration due to gravity – angular distance, speed and angular acceleration. Analysis Of Track Techniques: Starting, running, hurdling, stride length, frequency, sprint length, frequency and sprint start. Analysis Of Field Techniques: Standing broad jump, running broad jump, pole vault-techniques involved-guiding principles– (video demonstration of track and field events and the techniques).		9
III	BATS AND BALLS LINEAR KINETIC: Inertia-mass – force-momentum – Newton’s laws of motion – friction – impulse – impact – oblique impact – elasticity – impact on fixed surface, moving bodies. Analysis of Cricket / Base Ball: Impact – moment of inertia – spin – size of the ball-size of the bat – batting – stride – swing –		10

	bunting. Analysis Of Tennis Techniques: Grip- striking – serve – direction of flight of ball – guiding principles (video demonstrations of the above events).	
IV	DIFFERENT PROJECTILES IN SPORTS: Projectiles – horizontal and vertical motion-range of projectile – trajectory – Analysis of throwing events: techniques involved in speed of release, angle of release and reverse in shot-put, discus, javelin and hammer throw- analysis of broad jump-basket ball shooting and foot ball kicking (video demonstration of projectiles in sports) – guiding principles – analysis of basket ball techniques: Dribbling and passing.	10
V	THE GYMNASTICS AND ADVENTURE SPORTS: Eccentric force-moment – equilibrium – centre of gravity – weight – rotator and circular motion – Analysis of Gymnastics activities: Techniques of lift-rotation-take off – landing for long horse vault, parallel bar etc., - Analysis of rope climb, tight rope walking, skipping – car race, boat race, cycle race – guiding principles (video demonstration). Swimming And Diving: Basic ideas of flotation – buoyant force – centre of buoyancy – specific gravity - relative motion – fluid resistance – conservation of momentum – Analysis of swimming techniques – starting – racing – turn different strokes – diving techniques (video demonstration) Other Factors Influencing Performance: Air resistance – spin or gyration – available force – human characteristics – effects of gyroscopic action – guiding principles.	10
References	<p>Text Books</p> <ol style="list-style-type: none"> 1. The Biomechanics of Sports Techniques, Third edition, Hay.G.James – Relevant portion of chapters 3 to 10 & 12, 13 to 17. 2. Scientific Principles of Coaching, Second Edition – Relevant portion of chapters 5, 7 to 14, 16 to 21. 3. General Physics with Bioscience Essays, Marion and Nornyak, Second Edition– Chapters 1.2, 2.5, 2.8, 3.4, 4.2, 5.3, 7.3. 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: Identify the distribution of mass in human body CO 2: Calculate the food requirements and calorific content needed for a sports person CO 3: Describe the velocity, speed and acceleration during running. CO 4: Analyze the track techniques such as starting, running, hurdling, stride length, frequency and sprint length. CO 5: Analyze the techniques of Gymnastics activities.</p>	

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO 1	4	1	-	-	-	2	2		-
CO 2	2	1	-	-	-	2	3	-	-
CO 3	3	3	2	1	3	1	1	-	-
CO 4	3	3	-	-	-	1	1	2	-
CO 5	3	3	-	2	2	1	2	2	-

Mean = 56/44 = 2.07

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fourth	Course Code	21PHYU04G3
Course Title	Physics of Sound and Acoustics		
No. of Credits		No. of contact hours per Week	
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	50%
Category	Generic Elective -I		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • To understand about basic ideas of sound. • To give understanding about electronic instruments in sound. 		
UNIT	Content		No. of Hours
I	BASIC IDEAS OF SOUND: Wave motion – types of waves-simple Harmonic motion – Properties of sound waves – reflection, refraction, diffraction and interference of sound velocity of sound-standing waves-Beats-Resonance - difference between sound, noise and music - the seven scales of Indian music and the scales employed in western music		9
II	PROPERTIES OF SOUND : The ear-pitch loudness and quality of musical notes-just noticeable difference in pitch-barrel hearing-aural or combination tones-subjective tones-subjective music-vibrato and tremolo-pitch range of musical instruments-quality – Fourier’s theorem – maintaining pitch and the use of pitch pipe for tuning – tanpura		10
III	SOUND INSTRUMENTS: String instruments-frequency of stretched strings- longitudinal vibration in strings-plucked, bowed and struck stringed instruments-one example for each from Carnatic Hindustani and western – resonating box in Veena and violin - Wind Instruments modes of oscillation in open and closed pipes-Different types of wind instruments-examples from Carnatic and western – nadaswaram and flute - Vibrations in Stretched Membranes and Plates. Drums, cymbals etc – Ramans’ work on music.		10

IV	ELECTRONIC INSTRUMENTS OF SOUND: Microphones (carbon & crystal) – pickup for instruments – Loud speaker, Amplifiers – sound mixers- rms and peak music power output.	9
V	ACOUSTICS OF BUILDINGS : Tape recording - materials used for tape manufacture and their magnetic properties – history – ac and dc bias and the need for the same -and play back equalizers- multichannel recording and reproduction- Recording and reproduction of sound in cine films. Acoustic of Buildings: Aoustics- Reverberation and Reverberation time – Acoustic measurements: Acoustic intensity level – Acoustic pressure level- Factors affecting the acoustics of buildings – sound distribution in an Auditorium – Requisites for good acoustics.	10
References	<p>Text Books</p> <ol style="list-style-type: none"> 1. Physics of Musical sounds – Askill.J 2. Physics for you - Johnson. K 3. Waves - Berkely 4. Sound and Ultra sound - Freeman I.M. 5. Home Science Physics - Renganayakiamma 6. Musical Instruments of India - Krishnasami. S 7. Text book of Sound - Brijlal and Subramanyam 8. Instrumentation and Analysis – Nakra and Choudry. 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: Explain the types of wave motion CO 2: Indicate the different Properties of sound waves CO 3: Describe the musical scales and frequency rates. CO 4: Explain the modes and vibrations in stretched membranes. CO 5: Determine the acoustic intensity and pressure level of an auditorium.</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	-	1	1	2	-	2
CO2	3	3	1	2	2	2	2	2
CO3	3	2	-	3	2	2	2	2
CO4	3	3	1	2	2	2	2	2
CO5	3	3	1	2	2	2	2	2

Mean = 86/45 = 2.047

Semester	Fifth	Course Code	21PHYU0511
Course Title	Electromagnetics		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) 		
Course Objectives (Maximum: 5)	<p>TheCourseaims</p> <p>1) To make the students understand the basic concepts involved in electrostatics and electromagnetics</p> <p>2) To enable the students to solve problems involving electric field intensity, electric potential under various situations</p> <p>3) To give a knowledge on the fundamentals of electromagnetics so that they can be employed in future higher studies.</p> <p>4) To educate the students to apply the knowledge of electromagnetic induction in real time problems</p>		
UNIT	Content		No. of Hours
I	UNIT – I: Electrostatic fields in vacuum: Electric field outside and inside macroscopic bodies, Gauss’s law, the average potential over a spherical surface, Poisson and Laplace equations, conductors, calculation of electric field produced by a simple charge distribution, Field due to a uniform spherical charge distribution – Calculation of electric field inside and outside the charges, Coulombs law – Electric dipole-potential energy of a charge distribution, energy density in an electric field -		14
II	UNIT – II : Electrostatic fields in dielectric medium : Electric polarization, electric field at an exterior point, bound charge densities of surface and volume charge distribution, polarization current density, electric field at an interior point, electric field intensity due to distant dipole, the local field, electric susceptibility, divergence of electric field intensity and electric displacement, relative permittivity, Poisson’s equation for dielectrics, free and bound charge densities, calculation of electric field involving dielectrics, dielectric insulated parallel plate capacitor, free charge density, bound charge density and electric displacement at a dielectric conductor boundary, dielectric sphere with a point charge		13

	at its centre,	
III	<p>UNIT – III : Steady currents and nonmagnetic materials: Magnetic forces, magnetic induction B, Biot-Savart law – magnetic induction due to a current flowing in a long straight wire, forces between two long parallel wires, circular loop. The force on a point charge moving in a magnetic field – Hall effect in semiconductors, divergence of the magnetic induction, vector potential – long straight wire, pair of long parallel wires - curl of the magnetic induction, ampere’s circuital law-long cylindrical conductor, long solenoid - short solenoid.</p>	13
IV	<p>UNIT – IV : Magnetic Induction and magnetic energy: Faraday’s law of induction – expanding loop. Faraday induction law – differential form – Induced electric field intensity E in terms of vector potential A– electromotance induced in a loop by a pair of long parallel wires carrying a variable current, induced electromotance in a moving system- electromotance induced in a fixed loop in a time dependent magnetic field, electromotance induced in a loop rotating in a fixed magnetic field inductance and electromotance, mutual inductance, self inductance of a long solenoid, -mutual inductance between two coaxial solenoids, coefficient of coupling.</p>	12
V	<p>Magnetic materials: Magnetisation – Magnetic induction at an exterior point – at an interior point – Magnetic field intensity – Magnetic susceptibility and relative permeability – Hysteresis – energy dissipated in a hysteresis cycle.</p> <p>UNIT – V: Maxwells equations: Maxwell's equations in integral form - Differential form – Duality-Lorentz’s Lemma - - Non-homogeneous equations for E and B</p>	12
References	<p>TextBooks(withchapternumber&pagenumber,whereverneeded): Electromagnetic fields and Waves – Paul Lorrain and Dale Corson, II Edn. CBS Publishers and Distributors (1986), Pre-requisite: Chapter 1. Unit 1. Chapter 2: Pages 40-81 Unit 2. Chapter 3: Pages 91-115 Unit 3 Chapter 7: Pages 292 – 323 Unit 4. Chapter 8: Pages 332 - 364 Unit 5 : Chapter 9: Pages 383 to 400 & Chapter 10: Pages 439 to 450.</p>	
	<p>ReferenceBooks: 1. Electromagnetic waves and Radiating systems, II Edn. Edward C. Jordon & Keith G.. Balmain, Prentice Hall of India Pvt. Ltd., New Delhi (1993). 2. The Feynman Lectures on Physics, Vol.2 Feynman, Leighton and Sands Narosa Publishing House, 1964, Reprint (1993).</p>	
	<p><u>Related Online Courses – MOOC</u></p> <p>1) https://www.edx.org/course/dian-ci-xue-electromagnetism-tsinguax-uphys3x 2) https://www.edx.org/course/electricity-and-magnetism-magnetic-fields-and-forces 3) https://www.edx.org/course/electricity-and-magnetism-</p>	

	<p>electrostatics</p> <p>4) https://www.edx.org/course/preparing-ap-physics-c-electricity-georgetownx-phyx152x-1</p> <p>5) https://www.edx.org/course/apr-physics-2-part-2-electricity-ricex-advphy2-2x-0</p>
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: will be aware of electric dipoles, usage of Gauss's law, nature of electric field and potential due to simple charge distributions</p> <p>CO2: will be able to calculate electric field intensity and potential inside and outside point charge and arbitrary charge distributions</p> <p>CO3: will have knowledge on dielectrics, local field, electric polarization and displacement currents</p> <p>CO4: can analyse magnetic fields in closed conducting wires like solenoid, torroids, etc.,</p> <p>CO5: can solve problems in moving systems with the knowledge of magnetic induction and will be aware of Maxwell's equations</p>

Mapping of COs with PSOs:

PSO \ CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	2	3	-	1	2	2	2	3
CO2	2	3	3	2	2	2	3	3	3
CO3	3	2	3	-	1	2	2	2	3
CO4	2	3	3	2	3	2	3	3	3
CO5	2	3	3	2	2	2	3	3	3
CO6	2	3	3	2	3	2	3	3	3
CO7	3	2	3	-	2	2	2	3	3
CO7	2	3	3	-	-	1	3	3	3

$$\text{Mean} = 168/67 = 2.51$$

Strongly Correlated (S)	3marks
Moderately Correlated (M)	2marks
Weakly Correlated (W)	1mark
No Correlation (N)	0mark
Note: No course can have "0" (Zero) score	

Semester	Fifth	Course Code	21PHYU0512
Course Title	Nuclear and Particle Physics		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> Basic Skill / Advanced Skill 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> K-1: (Remember) K-2: (Understand) K-3: (Apply) K-4: (Analyze) K-5: (Evaluate) K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> To understand the fundamental properties of atoms. It gives a tool to understand different types of detectors. It provides the uses of radioactive elements in medicine, agricultural and industrial areas. 		
UNIT	Content	No. of Hours	
I	<p>THE CONSTITUENTS OF NUCLEUS AND SOME OF THEIR PROPERTIES:</p> <p>Introduction- Rutherford scattering an estimation of the nucleus size- measurement of nuclear radius- constituents of the nucleus and their properties- discovery of neutrons- nuclear spin, moments and statistics- Alpha decay, Beta decay and Gamma decay (Qualitative explanation only)</p>	12	
II	<p>RADIOACTIVITY: Introduction- properties of radioactive rays - The law of radioactive decay - unit of activity - Radioactive growth and decay - ideal equilibrium, transient equilibrium and secular equilibrium - radioactive series- radioactive isotopes of lighter elements - Artificial radioactivity - determination of the age of the earth - carbon dating-archaeological time scale - illustrative examples.</p>	12	
III	<p>PARTICLE ACCELERATORS, NUCLEAR REACTIONS, NUCLEAR MODELS AND REACTORS : PARTICLE ACCELERATORS:Low</p>	12	

	<p>energy cyclic accelerators: cyclotron (fixed frequency)- variable energy cyclotron- betatron- linear accelerator(electron linear accelerators only)– synchrotron(synchro cyclotron only)</p> <p>NUCLEAR REACTIONS: Types of nuclear reactions- conservation laws- nuclear reaction kinematics- nuclear transmutations: transmutation of alpha particles, transmutation of protons, transmutation of neutrons- nuclear fission & fusion- atom bomb and hydrogen bomb.</p> <p>NUCLEAR MODELS AND REACTORS: Nuclear models: liquid drop model and shell model only - nuclear reactors - general design of a nuclear reactors(basic reactors) swimming pool reactor, fast breeder reactor - chain reactions-fissile materials.</p>	
IV	<p>DETECTION AND MEASUREMENTS OF NUCLEAR RADIATIONS: Introduction- ionization chamber-Geiger Muller counter-scintillation counter- cloud chamber- bubble chamber-nuclear emulsions.</p>	12
V	<p>Unit-V: ELEMENTARY PARTICLES</p> <p>Introduction - classification of elementary particles - production properties of elementary particles – electron and positron – proton and anti-proton – neutrino and anti-neutrino – Mesons – Pions – K-Mesons - η mesons – hyperons - hyper nuclei – resonance states – quarks – isospin of quarks.</p>	16
References	<p>Text Books</p> <ol style="list-style-type: none"> 1. Nuclear Physics An Introduction by S.B.Patel (New age international (P) Ltd publishers- New Delhi-(2nd Edition)). Unit I : Pages 112-132 Unit II: Pages 57-66,70-87 2. Nuclear physics by D.C. Dhayal (Himalaya Publishing House-Fifth revised & enlarged edition Unit III: Pages 482-491,501-505, 401-408, 358-360, 360-362, 578-579, 585, 592-594, 626-628, 633-636, 638, 649 Unit IV: Pages 129-133,143-148,148-152,156-159,159-162,165-168 Unit V: Pages 692-696, 707-748 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: To give better insight to the students to provoke the fundamental radioactive decay, the concept of alpha, beta and gamma and learn about radioactive disintegration in terms of mean life, half life.</p> <p>CO 2: To know the types of Nucleons manifesting in isotopes, isobars and isotones.</p> <p>Furtherance, to understand the classifications of the light nuclei and heavy nuclei through empirical observations of binding energy per nucleon.</p>	

	<p>CO 3: To cover the description and utilization of different types of accelerators and viabilities and their limitations.</p> <p>CO 4: To give inquisitive importance of the detectors such as ionization chambers, GM counters and photo multiplier tubes and their characterization.</p> <p>CO 5: To give complete a account of presenting the cosmic rays and their phenomenological effects on Earth's magnetic field, the latitude and altitude effect.</p>
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Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	2	3	-	2	3	3	1	2
CO2	3	3	3	-	2	1	1	1	3
CO3	2	3	3	-	2	2	2	-	2
CO4	2	2	1	-	3	1	3	2	2
CO5	3	3	-	-	1	2	3	3	3

Mean= 86/45=2.26

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fifth	Course Code	21PHYU0513
Course Title	Classical Mechanics & Relativity		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> Basic Skill / Advanced Skill 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> K-1: (Remember) K-2: (Understand) K-3: (Apply) K-4: (Analyze) K-5: (Evaluate) K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> understand the Newton's law, virtual work and D'Alembert's principle understand the dynamical system moving with the relativistic speed. 		
UNIT	Content		No. of Hours
I	<p>LAGRANGIAN DYNAMICS: Introduction – basic concepts – constraints: Holonomic constraint – Nonholonomic constraint – some more examples of holonomic and nonholonomic constraints – force of constraints – difficulties introduced by the constraints and their removal – Generalized coordinates – principle of Virtual work – D'Alembert's principle – Lagrange's equations from D'Alembert's principle – procedure for formation of Lagrange's equation – Lagrange's equations in presence of Non-conservative forces – Generalized potential</p> <p>Lagrangian for a charged particle moving in an electromagnetic field (Gyroscopic forces) – Hamiltonian's principle and Lagrange's equations.</p>		12
II	<p>VARIATIONAL PRINCIPLES: Introduction – the calculus of variations and Euler- Lagrange's equations – deduction of Hamiltonian's principle from D'Alembert's principle – modified Hamiltonian's principle – deduction of Hamiltonian's equations from modified Hamiltonian's principle(or variational principle) – deduction of Lagrange's equations from variational principle for non-conservative</p>		12

	systems (Holonomic constraints).	
III	TWO BODY CENTRAL FORCE PROBLEM: Reduction of two-body central force problem to the equivalent one-body problem – central force and motion in a plane – equations of motion under central force and first integrals – differential equation for an orbit - inverse square law of force – Kepler’s law of planetary motion and their deduction: deduction of the Kepler’s first law – deduction of the Kepler’s second law – deduction of the Kepler’s third law(period of motion in an elliptical orbit) – stability and closure of orbit under central force – artificial satellites – Virial theorem.	12
IV	NONINERTIAL AND ROTATING COORDINATE SYSTEMS: Non-inertial frames of reference – fictitious or Pseudo force – centrifugal force – uniformly rotating frames – free fall of a body on Earth’s surface – Foucault’s pendulum.	14
V	UNIT – V:CANONICAL PERTURBATION THEORY Introduction – time dependent perturbation – illustration of time dependent perturbation theory – time independent perturbation theory – time independent perturbation theory to higher order – specialised perturbation techniques in classical and space mechanics – adiabatic invariants	14
References	Text Books Classical Mechanics by J.C.UPADHAYA Himalaya Publishing House second revised edition. Unit- I : Page no 27-53. Unit– II : Page no 138-149. Unit- III: Page no 103-125. Unit- IV: Page no 320-329. Unit- V : Page no 499-531.	
	Reference Books 1. Classical Mechanics-H. Goldstein – II Edition, Narosa Publishing House, New Delhi – 1995 2. Mechanics – Schaum’s series : Third Edition Chapter VII	
Course Outcomes	On completion of the course, students should be able to do CO 1: understand the Newton's law, virtual work and D'Alembert's principle CO 2: apply the Hamiltonian's and Lagrangian principle to solve the equation of motion for any mechanical problem. CO 3: solve the mechanical problem of dynamical system moving with constraints CO 4: reduce the two-body problem to one - body problem CO 5: understand the dynamical system moving with the relativistic speed.	

Mapping of COs with PSOs:

CO \ PSO	PSO							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	3	-	-	-	3	3
CO2	3	3	3	-	-	-	3	3
CO3	3	3	3	-	-	-	3	3
CO4	3	3	3	-	-	-	3	3
CO5	3	3	3	-	-	-	3	3

Mean= 90/30=3

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fifth	Course Code	21PHYU0514
Course Title	Practical V		
No. of Credits	2	No. of contact hours per Week	6
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	5%
Category	Practical		
Scope of the Course	Hands on training on sophisticated and ordinary instruments operation and their uses have been exposed		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • To give Hands on training on sophisticated and ordinary instruments operation • To understand about the Maintenance, reassembling and Servicing. 		
UNIT	Content		No. of Hours
I	<ol style="list-style-type: none"> 1. Study of CRO and its uses and study of Function generator. Testing of diodes, transistors. 2. Factors affecting induced emf in a coil and factors that determine the secondary emf & current in coupled coils – CRO 3. AC circuits – phase lead, phase lag and impedance 4. Measurement of inductance and capacitance – AC Bridges Maxwell and Owen. 5. Simple wiring 6. Study of Hysteresis of magnetic material 7. LCR circuits – series and parallel resonance – sharpness resonance and Q factor. 8. Study of motors 9. Maintenance, reassembling and 		

	<p style="text-align: center;">Servicing of</p> <ol style="list-style-type: none"> a. Balances b. Telescopes c. Microscopes d. Rheostats e. Galvanometers, Ammeters & Voltmeters <ol style="list-style-type: none"> 10. Hands on training in using simple tools 11. Voltage multipliers-diodes, Characteristic of a Transistor CE-mode-measurement of h parameters-load line 12. FET characteristics – measurement of parameters and load line 13. Design and study of a power supply with filter circuit 14. Design and study of a regulated power supply. 15. Design and study of a single stage voltage amplifier – BJT & FET. 16. Design and study of Hartley and Colpitt's oscillators 17. Study of Transducers. 	
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Semester	Fifth	Course Code	21PHYU05D4
Course Title	Instrumentation		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	25%
Category	Discipline Centric Elective		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>The principle of operation of ac voltmeters and millivoltmeters with preamplifiers will be introduced.</p>		
UNIT	Content		No. of Hours
I	<p>Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: measurement of dc voltage and dc current, ac voltage, ac current and resistance. how to choose a multimeter – its sensitivity – vacuum tube and FET input multimeters -their advantages over conventional multimeters- Principles of voltage, measurement (block diagram only). AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.</p>		10
II	<p>Introduction to cathode ray oscilloscope- Block diagram- . Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance – minimum maximum input voltages – input</p>		10

	capacitance and its effect - . Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.	
III	Basic principle of oscillators – low frequency and high frequency oscillators – signal generators with multiple output and attenuation - Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis	8
IV	AC bridges – balancing an ac bridge – dc and ac conditons - . working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter- Digital LCR bridges.	10
V	Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. Digital Multimeter- Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter (with block diagram), time- base stability, accuracy and resolution.	10
References	<p style="text-align: center;"><u>REFERENCE BOOKS:</u></p> <p>A text book in Electrical Technology - B L Theraja - S Chand and Co. Performance and design of AC machines - M G Say ELBS Edn. Digital Circuits and systems, Venugopal, 2011, Tata McGrawHill. Logic circuit design, Shimon P. Vingron, 2012, Springer.</p> <p>Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc- Graw Hill</p> <p>Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India</p>	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: will have a sound knowledge of terms like precision and accuracty</p> <p>CO2: will be capable of testing and standardizing meters like voltmeter, ammeter and ohmmeter</p> <p>CO3: Can make measurement of voltages, phase changes and frequency using CROs</p> <p>CO4: will be capable of testing the goodness of signal generators</p>	

	CO5: Can work with resonant circuits and design them
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Mapping of COs with PSOs:

CO \ PSO	PSO							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	1	3	2	-	2	2
CO2	3	3	1	3	2	-	2	2
CO3	3	2	1	3	2	-	3	2
CO4	3	2	-	3	2	-	2	3
CO5	3	2	2	3	2	-	2	3

Mean = 93/ 45 = 2.38

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fifth	Course Code	21PHYU05D5
Course Title	Television Transmission & receiver		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Discipline Centric Elective		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • Academic and practical knowledge on TV functioning and its servicing skill are incorporated. • be capable of understanding and operating video cameras. 		
UNIT	Content	No. of Hours	
I	Elements of a Television System : Picture transmission – sound transmission – picture reception – sound reception – picture synchronization – Basic monochrome transmitter and receiver – gross structure, image continuity, number of scanning lines, flicker, fine structure, total gradation – composite video signal – horizontal synchronization details – vertical synchronization details – function of vertical pulse train .	8	
II	UNIT – II: Signal Transmission: AM: Channel band – vestigial side band transmission – transmission efficiency – complete channel band width – reception of vestigial side band signals - demerits of vestigial side band transmission – FM: FM Channel band width –channel band width for colour transmission – Television signal stands – monochrome picture tube – beam deflection screen phosphor-face plate-picture tube characteristics – picture tube circuit controls.	10	
III	Camera principle – photoelectric effect – image storage principle – electron scanning beam – video signal electron multiplier – image	10	

	<p>orthicon – Videocon – plumb icon – CCD.</p> <p>TV receiver- Block diagram-antenna-RF section – IF section – vestigial side band correction – choice of IF – sound separation – sound section – sync processing – vertical deflection – EHT supply.</p>	
IV	<p>Colour Television : Compatibility – natural light – colour perception – three colour theory – luminance, Hue and saturation – colour TV camera – luminance signal – production of colour difference voltage – compatibility considerations – Delta gun picture tube – purity and convergence PIL colour picture tube pin cushion correction- Auto Degaussing circuit – grey scale tracking.</p>	10
V	<p>Television applications: Cable television MATV & CATV – closed circuit (CCTV) theatre television – Video tape recording play back – Television via satellite.</p> <p>Fault finding: Trouble shooting in monochrome receivers.</p>	10
References	<p>Text Books</p> <p>Monochrome and Colour Television 22nd Reprint R.R. Gulati, Wiley Eastern (1993) Page 5-48, 50-81, 82-96, 131-148, 540 – 555, 558-568, 576-580, 214-203 and 722-723).</p>	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: have a complete knowledge about transmission and reception of television signals.</p> <p>CO 2: be able to differentiate between various sync signals</p> <p>CO 3: identify defects in a TV and can suggest remedies</p> <p>CO 4: be capable of understanding and operating video cameras</p> <p>CO 5: be able to install and operate DTH and cable television.</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	-	1	1	1	2	3
CO2	3	2	-	2	2	-	2	3
CO3	3	3	-	3	1	1	1	3
CO4	3	-	1	3	-	1	-	3
CO5	3	1	2	2	-	-	2	3

Mean = 87/ 36 = 2.41

Semester	Fifth	Course Code	21PHYU05D6
Course Title	Microprocessor 8085 Programming		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Discipline Centric Elective		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to <ul style="list-style-type: none"> • Acquire the knowledge on fundamentals of Microprocessors • Acquire knowledge about memory mapping • Write a program for a specific application • Gain knowledge for debugging of programs Find the features of microcontrollers, design and construct circuits for social needs.		
UNIT	Content		No. of Hours
I	UNIT–I: MICROPROCESSOR ARCHITECTURE & MICROCOMPUTER SYSTEM AND INTRODUCTION TO 8085 ASSEMBLY LANGUAGE PROGRAMMING: Microprocessor architecture and its operations – Microprocessor initiated operations and 8085 bus organization – Internal data operations and the 8085 registers –Peripheral or externally initiated operations – Memory – – Memory Address of a 1K Memory chip – – Instructions classification –		12
II	INTRODUCTION TO 8085 INSTRUCTIONS: Data transfer operations – Arithmetic operations – Logic operations–Branch operations–Writing assembly language programs– Debugging a program.		10
III	PROGRAMMING TECHNIQUES WITH ADDITIONAL INSTRUCTIONS: Programming techniques – looping – counting and indexing – Additional data transfer and 16 bit arithmetic instructions –Arithmetic operations related to		10

	memory – Logic operations – – Dynamic debugging.	
IV	COUNTERS AND TIME DELAYS : Counters and Time delays – Hexadecimal counter – Generating pulse waveforms – Debugging counter and time delay programs. STACK AND SUBROUTINES: Stack – Subroutine – – Advanced subroutine concepts..	8
V	GENERAL PURPOSE PROGRAMMABLE PERIPHERAL DEVICES: The 8255A Programmable Peripheral Interface – Interfacing Keyboard and Seven Segment Display.	8
References	<p><u>BOOKS FOR STUDY:</u></p> <p>Microprocessor Architecture, Programming and Applications with the 8085– R.S. Gaonkar, Wiley Eastern, Fourth edition, New Delhi. Unit I : Chapter 2 Pages: 25–63 and Chapter 5 Pages 139–159 Unit II : Chapter 6 Pages: 161–211 Unit III : Chapter 7 Pages: 213–260 Unit IV : Chapter 7 Pages: 213–260 Unit V : Chapter 15 Pages: 445–471</p>	
	<p><u>BOOKS FOR REFERENCE:</u></p> <ol style="list-style-type: none"> 1. Introduction to microprocessors- II – A.P. Mathur (1988) Edn., TMH, New Delhi. 2. 8080A / 8085 assembly language programming – L.A. Leventhal 3. 8080A / 8085 assembly language subroutines – L.A.Leventhal and W. Saville. 	
	<p>E-Resources (URLs of e-books / YouTube videos / online learning resources, etc.)</p> <ol style="list-style-type: none"> 1. https://www.edx.org/course/embedded-systems-shape-the-world-microcontroller-inputoutput https://www.edx.org/course/embedded-systems-shape-the-world-multi-threaded-interfacing 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: understand the memory devices and their mapping CO 2: use the instruction for program writing CO 3: write assembly language programs using logical, branching and looping instructions CO 4: apply the knowledge gained for debugging of programs CO 5: use the knowledge gained to generate waveforms using display loops</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	-	1	-	-	-	-	1	1
CO2	-	1	-	1	1	-	2	2
CO3	-	-	-	-	-	-	-	1
CO4	-	1	1	2	2	2	2	2
CO5	-	2	-	3	3	3	2	3

Mean = 39 / 40 = 1.77

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fifth	Course Code	21PHYU05S1
Course Title	Instruments and Servicing		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	25%
Category	Generic Elective		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to This course will also provide a back ground on working with Meter Bridge and potentiometer circuits. The course will make the student understand the basics about conversion of a galvanometer to an ammeter and calibrating them.		
UNIT	Content		No. of Hours
I	GENERAL IDEAS: DC power supply – basics of half and full wave rectifier – loading effects, filters and measurement of ripple factor- fault finding and servicing – characterization of a power supply-use of measuring instruments; understanding of voltmeter, ammeter and ohm meter and multi tester understanding and testing for the correctness of specifications for instruments (audio oscillator, cathode ray oscilloscope, voltmeter and ammeter) - clamp tester and its uses		10
II	INSTRUMENTS IN THE PHYSICS LABORATORY : Theory and measurements with (i) meter bridge: basic principle, need for good detector - possible errors in not able to balance the bridge (ii) potentiometer (Comparison of emfs, resistances, measurement of potentials)- the supremacy of potentiometer over voltmeters in measuring oper circuit voltages - fault finding in metre bridge and potentiometer circuits – power measurement using tree voltmeters – transformers principle, reflected impedance and winding & transformers		10

III	INSTRUMENTS IN THE PHYSICS LABORATORY II: Moving coil / iron galvanometers: theory and characterization – conversion of a galvanometer into an ammeter/voltmeter - sensitivity of the galvanometer employed - and their calibration-ballistic galvanometer: construction, working (alignment) and characterization, measurement of: absolute capacity, High resistance by leakage of a capacitor and mutual inductance	10
IV	RADIO AND TELEVISION: Need for radio waves and modulation - radio transmission – simple radio receiver for AM and the super heterodyne receiver and its servicing – fundamentals of television - basics of television receiver with a block diagram- simple fault finding in TV receivers and precautions to be adopted-high voltage measurement-various colour systems like PAL, NTSE and SECAM - colour mixing and other controls in a colour TV - magnetic tape recording principle and block diagram for the same-fault finding and servicing	10
V	ELECTRICAL DEVICES AND OTHERS: Earthing-tube light circuit and servicing –Emergency lamp and its operation- UPS (block diagram) – simple ideas about a digital clock – alarm and sleep – frequency meter (block diagram) – Item counter – automatic street light operation. Need for all these equipments	8
References	<p style="text-align: center;"><u>BOOK FOR STUDY:</u></p> <p>Modern Electronic Instrumentation and measurement techniques, A.D. Helfrick and W.D.Cooper, Prentice-Hall of India, New Delhi, 2002. Relevant portions</p>	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: will be able to use a multimeter for measuring various electrical parameters</p> <p>CO 2: will be trained in testing the goodness of specifications of audio oscillators and other instruments</p> <p>CO 3: Will be capable of converting a galvanometer for appropriate measurements</p> <p>CO 4: will be able to make minor repairs on radio receivers and TVs</p> <p>CO 5: can make minor repairs and maintain street lights, UPS and such other systems.</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	-	3	1	-	2	1
CO2	3	1	-	3	1	-	2	2
CO3	3	1	-	2	1	-	2	2
CO4	3	1	-	2	2	1	2	2
CO5	3	1	3	3	2	1	2	2

Mean = 73/ 45 = 1.92

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	FIFTH	Course Code	21PHYU05G5
Course Title	Agricultural Physics		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Generic Elective -II		
Scope of the Course (may be more than one)	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	The Course aims to Basics of physics related to agriculture area is exposed.		
UNIT	Content		No. of Hours
I	Basic concepts of physics - Importance of physics related to agriculture- physical laws – Brownian movement – Tyndoll effect – Raman Effect – Spectroscopy – Adhesion and Cohesion properties – relevant to agriculture.		10
II	Soil physics- soil moisture movement – physical classification of soil moisture – soil air movement – thermal diffusion in soils – thermal properties of soils – heat capacity – heat conductivity – specific heat.		10
III	Nanophysics - nano particles – physical properties of nanoparticles – Moore’s law – semi conductors – diode – biosensors – quantum dots – working principles of Transmission Electron microscope – Scanning Electron Microscope – Scanning Tunneling Microscope – their applications		10
IV	Soil – plant - water continuum – capillary movement of water in soil and plant – tortousity of water in soils – Hysterisis effect – osmosis – diffusion .		8
V	Physical constraints in agriculture – soil constraints – impermeability of soil – compaction methods – physical constants of soils – Soil physics as a factor in soil management.		10

References	<p>Text Books (with chapter number & page number, wherever needed):</p> <ol style="list-style-type: none"> 1. William Lambe, T. and Robert V. Whitman. 1979. Soil Mechanics. Wiley Eastern Ltd. New Delhi. 2. Helmut Kohnke, 1979. Soil Physics. Tata McGraw-Hill Publishing Company Ltd. New Delhi. 3. Biswas, T.D. and Mukherjee, S.K. 1997. Text book of soil science. Tata McGraw-Hill Publishing Company Ltd. New Delhi. 4. Chinnamuthu, C.R., B.Chandrasekaran and C.Ramasamy, 2007. Nanotechnology Applications in Agriculture. TNAU Offset & Printing Press, Directorate of Open and Distance Learning, TNAU, Coimbatore.
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: Will understand the basic concepts of Physics related to agriculture.</p> <p>CO2: Will be able to analyse the various properties of soil.</p> <p>CO3: Will understand the technologies for characterization of nano particles.</p> <p>CO4: will recognize the effects of water in soil.</p> <p>CO5: will be able to analyse the physical constraints in agriculture.</p>

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO 1	3	2	1	-	2	2	2	2	1
CO 2	3	3	2	2	3	2	2	2	1
CO 3	2	2	3	2	3	2	3	3	2
CO 4	3	2	2	2	2	2	3	3	3
CO 5	2	3	2	2	2	3	3	3	3

$$\text{Mean} = 102/45 = 2.31$$

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Fifth	Course Code	21PHYU05G6
Course Title	PHYSICS OF CRYSTAL		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	100%
Category	Generic Elective		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to Give the Symmetry, properties and the crystal structures. Give the basic understanding of crystals.		
UNIT	Content	No. of Hours	
I	Introduction to crystals and minerals – Crystals and crystalline structures; Origin of minerals and crystals; Crystals in nature; mineral and crystal identification and its naming conventions; history of crystal mining; uses and application of crystals	10	
II	Fundamentals of crystals – Naturally Occurring Chemical Elements; Atomic and Ionic Radii; Crystals and crystal structures, Lattices, planes and directions; Pauling's Rules; Forces holding crystal structures together; Atomic substitutions.	10	
III	Introduction to Crystallography: Symmetry elements and operations; Six crystal systems; Crystal projections; Space groups and polymorphism; Diffraction and crystal structures	10	
IV	Liquid Crystals - Introduction to liquid crystals; history behind the development of liquid crystals; physics of liquid crystals; development of Liquid Crystal Displays (LCD) and its applications.	8	
V	Precious crystals and its properties: History of precious	10	

	crystals; Diamond mining in India; Physical properties of diamonds and sapphire; crystal structure and growth; Mechanical, optical and thermal properties of diamonds and sapphire; artificial diamonds; diamond polishing
References	<p>BOOKS FOR STUDY AND REFERENCE:</p> <ol style="list-style-type: none"> 1. Chapters 1- 5 in Earth Materials - Introduction to Mineralogy and Petrology (2017) Cornelis Klein and Anthony R. Philpotts, Cambridge University Press, ISBN 978-1-107-15540-4 2. Crystals and Crustal Structures (2006) Richard J. D. Tilley, John Wiley & Sons Ltd, ISBN 13: 978-0-470-01820-0] 3. Liquid Gold - The Story of Liquid Crystal Displays and the Creation of an Industry (2005) Joseph A. Castellano, World Scientific Publishing Co. Pte. Ltd., ISBN 981-238-956-3 4. Soap, science, and flat-screen TVs (2011) David Dunmur and Tim Sluckin, Oxford University Press] 5. Physical Properties of Diamond and Sapphire (2019) Roshan L. Aggarwal and Anant K. Ramdas, CRC Press, ISBN:13: 978-0-367-23508-6]
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: Will give a comprehensive review about crystals. CO2: Will give the basic skeleton of crystals. CO3: Will give the Symmetry , properties and the crystal structures. CO4: will give the basic understanding of crystals. CO5: will provides the valuable information about precious crystals and their properties</p>

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO 1	3	2	1	1	2	2	2	2	1
CO 2	3	3	2	2	3	2	2	2	1
CO 3	2	2	3	2	3	2	3	3	2
CO 4	3	2	2	2	2	2	3	3	3
CO 5	2	3	2	2	2	3	3	3	3

Mean = 103/ 45= 2.28

Semester	Fifth	Course Code	21PHYU05S2
Course Title	APPLIED OPTICS		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	5%
Category	Skill Based Course		
Scope of the Course (may be more than one)	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship • Value-Added Courses imparting transferable and life skills • Field Placement / Field Project • Internship 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	The Course aims to To impart knowledge about Fourier optics, Holography and Fiber Optics.		
UNIT	Content	No. of Hours	
I	Sources: Different kinds of sources: Polychromatic, Quasi monochromatic and Monochromatic – comparison between sodium lamp, mercury lamp and a laser - Lasers, Einstein's coefficients - Spontaneous and stimulated emissions- their ratio under thermal equilibrium, Theory of laser action, , Light amplification, Characterization of laser beam, three level and four level lasers - He-Ne laser, Semiconductor lasers	7	
II	Fourier Optics: Fourier transforms - Concept of Spatial frequency filtering, Fourier transforming property of a thin lens.	6	
III	Holography: Basic principle and theory: coherence, resolution, Types of holograms: Gabor and Leith-Upatnieks hologram - white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.	7	

IV	Photonics: Fibre Optics: Total Internal reflection at an interface – Optical fibres and their properties- different modes of propagation- loss less propagation of light - single mode, graded index and step index fibers -, Light coupling to a fiber - The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.	7
V	Detectors for fiber optics: LDR as a detector- its nonlinearity – photodiode – photomultiplier and CCDs	5
References	Text Books (with chapter number & page number, wherever needed): Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill Fibre optics through experiments,M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4 th Edn., 1996, Cambridge Univ. Press 1.	
Course Outcomes	On completion of the course, students should be able to do CO 1: Explain Theory of laser action and Einstein’s coefficients CO 2: Describe the Characterization of laser beam, He-Ne laser and Semiconductor lasers CO 3: State the Concept of Spatial frequency filtering. CO 4: Illustrate the Fourier transforming property of a thin lens CO 5: Describe the principle and theory of holography and types of holograms.	

Mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO 1	3	3	2	-	-	1	1	2	1
CO 2	3	3	1	-	1	1	2	2	1
CO 3	3	2	2	-	-	2	1	2	2
CO 4	3	3	3	-	-	2	1	2	2
CO 5	3	3	3	2	2	2	2	2	2

Mean = 78/45 = 2.05

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	FIFTH	Course Code	21PHYU05S1
Course Title	Instruments and Servicing		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	Skill Base Elective		
Scope of the Course (may be more than one)	<ul style="list-style-type: none"> • Basic Skill • Skill Development • Employability 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to find minor repairs on radio receivers and TVs</p> <p>make minor repairs and maintain street lights, UPS and such other systems</p>		
UNIT	Content		No. of Hours
I	<p>GENERAL IDEAS: DC power supply – basics of half and full wave rectifier – loading effects, filters and measurement of ripple factor- fault finding and servicing – characterization of a power supply-use of measuring instruments; understanding of voltmeter, ammeter and ohm meter and multi tester understanding and testing for the correctness of specifications for instruments (audio oscillator, cathode ray oscilloscope, voltmeter and ammeter) - clamp tester and its uses</p>		10
II	<p>INSTRUMENTS IN THE PHYSICS LABORATORY : Theory and measurements with (i) meter bridge: basic principle, need for good detector - possible errors in not able to balance the bridge (ii) potentiometer (Comparison of emfs, resistances, measurement of potentials)- the supremacy of potentiometer over voltmeters in measuring open circuit voltages - fault finding in metre bridge and potentiometer circuits – power measurement using three voltmeters – transformers principle, reflected impedance and winding &</p>		10

	transformers	
III	INSTRUMENTS IN THE PHYSICS LABORATORY II: Moving coil / iron galvanometers: theory and characterization – conversion of a galvanometer into an ammeter/voltmeter - sensitivity of the galvanometer employed - and their calibration-ballistic galvanometer: construction, working (alignment) and characterization, measurement of: absolute capacity, High resistance by leakage of a capacitor and mutual inductance	10
IV	RADIO AND TELEVISION: Need for radio waves and modulation - radio transmission – simple radio receiver for AM and the super heterodyne receiver and its servicing – fundamentals of television - basics of television receiver with a block diagram- simple fault finding in TV receivers and precautions to be adopted-high voltage measurement-various colour systems like PAL, NTSE and SECAM - colour mixing and other controls in a colour TV - magnetic tape recording principle and block diagram for the same-fault finding and servicing	10
V	ELECTRICAL DEVICES AND OTHERS: Earthing-tube light circuit and servicing –Emergency lamp and its operation- UPS (block diagram) – simple ideas about a digital clock – alarm and sleep – frequency meter (block diagram) – Item counter – automatic street light operation. Need for all these equipments	8
References	Modern Electronic Instrumentation and measurement techniques, A.D. Helfrick and W.D.Cooper, Prentice-Hall of India, New Delhi, 2002. Relevant portions	
Course Outcomes	On completion of the course, students should be able to do CO1: testing the goodness of specifications of audio oscillators and other instruments and use a multimeter for measuring various electrical parameters CO2: compare potentials using potentiometer circuits CO3: use a galvanometer for appropriate measurements CO4: make minor repairs on radio receivers and TVs CO5: make minor repairs and maintain street lights, UPS and such other systems	

Mapping of COs with PSOs:

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	1	-	-
CO2	3	2	2	-	-
CO3	3	3	3	-	-
CO4	3	2	2	2	1
CO5	3	3	1	3	2

Mean = 44/25 = 2.31

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	FIFTH	Course Code	21PHYU05S3
Course Title	WEATHER FORECASTING		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Skill-based elective		
Scope of the Course (may be more than one)	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development • Employability 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques</p>		
UNIT	Content	No. of Hours	
I	Introduction to atmosphere: Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature, with height; air temperature; requirements to measure air temperature, temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics.	9	
II	Measuring the weather: Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws.	5	
III	Weather systems: Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.	4	

IV	Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate.	6
V	Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.	8
References	Text Books (with chapter number & page number, wherever needed): 1. Aviation Meteorology, I.C. Joshi, 3 rd edition 2014, Himalayan Books 2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press. 3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur. 4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur. 5. Why the weather, Charls Franklin Brooks, 1924, Chpraman & Hall, London. 6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.	
Course Outcomes	On completion of the course, students should be able to do CO 1: Define the physical structure and compositional layering of the atmosphere. CO 2: Explain the variation of pressure and temperature at the atmosphere. CO 3: Define characteristics of cyclones and anticyclones. CO 4: State the measuring methods of wind speed and direction. CO 5: Explain about the radiation, absorption, emission and scattering in the atmosphere	

Mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO 1	3	2	1	-	-	2	2	2	2
CO 2	3	2	2	-	-	2	1	2	2
CO 3	3	3	3	-	-	2	-	2	2
CO 4	3	2	2	2	1	2	2	2	2
CO 5	3	3	1	3	2	2	3	2	1

Mean = 81/45 = 2.13

Semester	Sixth	Course Code	21PHYU0615
Course Title	Solid State Physics		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	25%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p style="text-align: center;">The Course aims to</p> <ul style="list-style-type: none"> • Acquire the knowledge of fundamental principles, phenomena and concepts in solid state physics. • Understand and describe the different experimental X-ray diffraction methods and lattice vibration, free-electron, band theories of solids. • Explain the theories underlying dielectric, optical, magnetic and superconductive properties. • Classify the properties of semiconductors, dielectrics, optical, magnetic and superconductive materials. <p style="text-align: center;">Apply the theories to explain the properties of solids.</p>		
UNIT	Content	No. of Hours	
I	Introduction- lattice points and space lattice-basis and crystal structure – Unit cells and lattice parameters -- unit cells versus primitive cell- crystal systems – crystal symmetry – the twenty three symmetry elements in cubic crystal-to show that five-fold rotation axis is not compatible with a lattice – symmetry operations-combination of symmetry elements- Rotation-Inversion axis – translation symmetry elements – Space groups – the Bravais space lattices – Metallic crystal structure - Relation between the density of crystal Material and Lattice constants in a cubic lattice - Other cubic structures.	10	
II	Directions Planes and Miller Indices – Important features of Miller indices of crystal Planes - important planes and directions in a cubic	9	

	crystal – distribution of atoms in the atomic plane of simple cubic crystal- Reciprocal Lattice Braggs Law – Braggs X-ray Spectrometer - Powder Crystal method - Rotating Crystal Method.	
III	Introduction - Lattice specific heat – Classical theory - Einstein’s theory of Specific Heat – Debye’s theory of Specific Heat – vibrational modes of a continuous medium – density of vibrational modes – Debye approximation. 5	9
IV	Superconductivity – Survey of superconductivity – Joule heating – An account of the mechanism of superconductors – Effect of Magnetic field – A.C. Resistivity – Critical currents – Meissner Effect – Thermal properties – The Energy Gap – mechanical effects – The penetration depth – Type I and Type II superconductors – London Equations.	10
V	Introduction – The Band structure of Semiconductors – Intrinsic semiconductors – Conductivity and temperature – Statistics of electrons and holes in intrinsic semiconductors – statistics of extrinsic semiconductors – mechanism of current conduction in semiconductors.	10
References	<p style="text-align: center;"><u>BOOKS FOR STUDY AND REFERENCE:</u></p> <p>. Solid State Physics by S.O. Pillai , New Age International Publishers, V Edn (2002) Unit I : Pages 100 to 127. Unit II : Pages 127 to 138, and Pages 154 to 166. Unit III : Pages 375 to 395 Unit IV : Pages 400 to 425 Unit V : Pages 595 to 640.</p>	
	<p style="text-align: center;"><u>BOOK FOR REFERENCES:</u></p> <p>1) Introduction to Solid State Physics by C. Kittel , Wiley Eastern (1984) 2) Elements of Solid State Physics by Ali Omar, Addison Wesley (1998)</p>	

Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: will be aware of basics of crystallography and its symmetry operations.</p> <p>CO 2: will be able to understand the concept of reciprocal lattice and importance of X-ray diffraction.</p> <p>CO 3: will become capable of using various theories on specific heat and its behavior to specific applications.</p> <p>CO 4: will become capable of understanding the phenomena of superconductivity and its impact due to magnetic, thermal and mechanical effects.</p> <p>CO 5: capable of utilizing the properties of semiconductors and its behavior for device applications.</p>
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Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	2	1	3	1	-	-
CO2	3	3	1	-	3	1	-	2
CO3	3	3	3	2	-	-	3	2
CO4	3	3	3	-	2	2	3	3
CO5	3	3	2	-	-	3	2	3

Mean = 80 / 33 = 2.42

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Sixth	Course Code	21PHYU0619
Course Title	Quantum Mechanics		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	Application of quantum mechanics as a tool to solve fundamental physics problems		
UNIT	Content	No. of Hours	
I	Origin of the Quantum Theory: Limitation of classical physics- Planck`s quantum hypothesis- Einstein`s theory of photoelectric effect-Compton effect- quantum theory of specific heat-Bohr theory of Hydrogen atom-existence of stationary states-Wilson- Sommerfeld quantisation rule – Elliptic orbit of Hydrogen atom-the Harmonic oscillator-the rigid rotator- particle in a box-the correspondence principle-the Stern-Gerlach experiment –inadequacy of Quantum theory.	10	
II	Wave Mechanical Concepts: Wave nature of particle –the uncertainty principle – the principle of superposition-wave packet-time dependent Schrodinger equation – interpretation of wave function—Ehrenfest theorem – time independent Schrodinger equation-Stationary states-admissibility condition on the wave function.	10	
III	General Formalism of Quantum Mechanics: – Linear vector space – Vector in a three dimensional space – Vector in an n- dimensional space – Hilbert space – Orthogonal functions– Schmidt orthogonalization process - postulatesofquantummechanics– Wave function – eigen function - operators- Kinetic energy operator – angular momentum components – expectation values – eigen	10	

	values –Time development of a quantum system – related problems	
IV	One Dimensional Energy Eigenvalue Problems: Particle in a box with infinite barrier potential – symmetric and antisymmetric wave function – energy eigen value – Particle in a box with finite barrier potential – Quantum mechanical tunneling – examples of quantum mechanical tunneling - – linear harmonic oscillator – Schrodinger method.	8
V	Three Dimensional Energy Eigenvalue Problems: particle moving in a spherically symmetric potential – system of two interacting particles –hydrogen atom – Hydrogenic orbitals –three dimensional square well potential.	10
References	<p style="text-align: center;"><u>BOOKS FOR STUDY AND REFERENCE:</u></p> <p>Quantum Mechanics by G.Aruldas (PHI) -2006</p> <p>Unit I : Pages: 1 to 21 of chapter 1.</p> <p>Unit II : Pages 22 to 48 of chapter 2.</p> <p>Unit III : Pages 53 to 62 of chapter 3.</p> <p>Unit IV : Pages 81 to 90 and pages 95 to 100.</p> <p>Unit V : Pages 114 to 130 and 132 of chapter 5.</p>	
	<p style="text-align: center;"><u>BOOK FOR REFERENCES:</u></p> <ol style="list-style-type: none"> 1. Quantum Mechanics by J.L. Powell and B. Crasemann, Oxford & IBH Publishing (1961). 2. A Text book of Quantum Mechanics by P.M.Mathews and K.Venkatesan, TMH (1971) 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: understand the limitations of classical physics and the need of quantum theory</p> <p>CO2: understand the importance of wave- particle duality and de Braglie concept</p> <p>CO3: understand the general formalism of quantum mechanics, uncertainty principle and schrodinger wave equation</p> <p>CO 4: apply the quantum mechanical formalism and schrodinger equation to solve problems one dimensional, three dimensional eigen value problems: square well potential, harmonic oscillator and hydrogen atom</p> <p>CO 5: Understand the applications of quantum mechanical</p>	

	tunnelling to alpha particle emission, tunnel diode, TEM etc. and to appreciate the same.
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Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO 9
CO1	3	3	3	-	-	-	3	3	3
CO2	3	3	3	-	-	-	3	3	3
CO3	3	3	3	-	-	-	3	3	3
CO4	3	3	3	-	-	-	2	3	3
CO5	1	1	1	-	-	-	1	3	3

Mean = 81/30=2.7

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Sixth	Course Code	21PHYU0617
Course Title	Spectroscopy		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Core Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to understanding the basics of spectroscopy and the interaction of atoms with electric, magnetic fields.		
UNIT	Content	No. of Hours	
I	Spectra of Atoms; Hydrogen Spectrum – Angular Momentum – Larmor Precession – Energy of a Magnetic Moment in a Magnetic Field – The Vector Atom Model – Spin-Orbit Interaction – Spectra of Alkali Atoms – Angular Momentum of Many Electron Atoms – Energy Levels and Spectral Transitions of Helium – Spectral Terms of Equivalent Electrons – Normal Zeeman Effect – Anomalous Zeeman Effect – Paschen-Bach Effect – Influence of Nuclear Spin- Hyperfine Structure – Stark Effect – Rydberg Atoms – Lamb Shift – Characteristic X-Ray Spectra – Moseley’s Law – Molecular Orbital Method.	12	
II	Visible spectroscopy: Theory of spectrophotometry and colorimetry –Lambart’s law – Beer’s law – Deviation from Beer’s law – Instrumentation: Source- Filters and monochromators –Sample cells – Detection – photo electric colorimeters – single beam and double beam instruments – quantitative analysis.	10	
III	Infrared Spectroscopy: The vibrating diatomic molecule – Energy of a diatomic molecule – simple harmonic oscillator – Anharmonic oscillator – Diatomic vibrating rotator – vibrations of polyatomic molecules –	12	

	fundamental vibrations and their symmetry – Overtones and combination frequencies – Double and single beam I.R. spectrophotometer operation. postulates of quantum mechanics - simultaneous measurability of observables - general uncertainty relation –relevant problems.	
IV	Raman Spectroscopy : Quantum and classical theory of Raman effect – Pure rotational Raman spectra of linear molecules – Rule of mutual exclusion – Vibrational Raman spectra – Rotational fine structure – structure determination from Raman and IR Spectroscopy – Techniques and Instrumentation.	12
V	Electronic Spectroscopy: Electronic Spectra of diatomic molecules - The Born – Oppenheimer Approximation – Vibrational Coarse Structure – Franck-Condon Principle – Dissociation Energy and Dissociation Products – Rotational Fine Structure of Electronic- Vibration Transitions – Fortrat Diagram – Pre dissociation.	12
References	<p><u>BOOKS FOR STUDY AND REFERENCE:</u></p> <p>1. Molecular structure and Spectroscopy, G.Aruldas, Prentice Hall of India Private Limited, New Delhi – 110 001, Third Printing. Unit I : Page No: 56 – 91</p> <p>2. Fundamentals of Molecular Spectroscopy, C.N. Banwell and M.Mc. Cash, IVth Edition, Tata McGraw Hill (1996).</p> <p>Unit-III: Pages: 55–66; 71–75; 91–93, chapter 3. Unit- IV: Pages: 100–106; 112, 113–116; 119–124 .</p>	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: will become capable of understanding the basics of spectroscopy and the interaction of atoms with electric, magnetic fields.</p> <p>CO2: will be able to analyze and apply visible spectrometry.</p> <p>CO 3: will be capable of understanding various kinds of vibrations on different molecules and IR instrumentation.</p> <p>CO 4: will be able to do structural exploration through IR and Raman spectra.</p> <p>CO 5: will be aware of electronic – vibration transitions and Born–Oppenheimer approximation</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	2	-	-	2	3	3
CO2	3	3	3	-	2	2	-	2
CO3	3	2	3	1	-	-	2	2
CO4	3	2	3	3	-	2	-	2
CO5	3	3	2	-	-	2	2	3

Mean = 82 / 33 = 2.48

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Sixth	Course Code	21PHYU0621
Course Title	Practical – VI		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	10%
Category	Practical		
Scope of the Course	Core Course		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • Explore to elemental presence by spectroscopy techniques. • To understand the various performances of logic gates in electronic circuits. 		
UNIT	Content		No. of Hours
I	<ol style="list-style-type: none"> 1. Photography – Developing and printing 2. CDS – Photographing arc spectra- Hartmann’s formula 3. Solar Spectrum – Spectrometer 4. Rydberg’s constants. 5. Ellipic and hyperbolic frings – Determination of Elastic constants 6. Determination of Plank’s constant 7. Determination of charge of an electron 8. Design of regulated power suppliers – IC 723, IC 7805 and study of regulation 9. Study of Basic Logic gates – Transistor and IC version 10. OPAMP – 741 as amplifier, inverting, non-inverting – Unit gain buffer. Integrator, differentiator, summer, solution of equations, wave form generator 11. Multi vibrators – Transistor, OPAMP and IC 555. 12. Study of 555 Timer 		

	<ul style="list-style-type: none">13. Study of trouble shooting in some simple electronic circuits14. Michelson interferometer15. Study of Doppler Effect16. Verification of Boolean relations DeMorgan's theorem – Combinational Logic17. Half adder, full adder and half subtractor	
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Semester	Sixth	Course Code	21PHYU06M1
Course Title	Statistical Mechanics		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	50%
Category	Modular Course		
Scope of the Course	<ul style="list-style-type: none"> Basic Skill / Advanced Skill 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> K-1: (Remember) K-2: (Understand) K-3: (Apply) K-4: (Analyze) K-5: (Evaluate) K-6: (Create) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <ul style="list-style-type: none"> To understand the mechanics of macroscopic system as well as microscopic system It gives understanding about classical statistics and Quantum statistics 		
UNIT	Content		No. of Hours
I	Statistical Mechanics : Microstate and macrostate – thermodynamic probability – Bose-Einstein, Fermi – Dirac, Maxwell - Boltzmann statistics – Bose-Einstein, Fermi – Dirac and Maxwell - Boltzmann - Distribution function. The partition function.		16
II	Application of Statistical Mechanics: Distribution of molecular velocities – Experimental verification – Einstein’s theory of specific heat capacity of a solid – Debye theory of specific heat capacity of solids – Black body radiation – The electron gas.		16
References	<p>Text Books Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W.Sears and Gerhadd L. Salinger – Third Edition, Narosa Publishing House. Unit I: Pages: 302–337 of chapter 11. Unit II: Pages: 354–366 of chapter 12, and Pages: 386–398; 407–416 of chapter 13</p>		

Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: gives elementary idea on the subject CO2: understand the classification of particles</p>
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Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	2	3	-	2	-	3	2
CO2	3	2	3	-	2	-	3	2

Mean = 36/18= 2.57

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Sixth	Course Code	21PHYU06M2
Course Title	Electric Circuit Analysis		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	42%
Category	Modular Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to To provide the students with knowledge of electrical network theorem and electrical component properties. The student will be given inputs regarding various combinations of R, L and C so that these circuits will be understood.		
UNIT	Content	No. of Hours	
I	Network Theorem: Kirchoffs voltage and current laws - Thevenin's theorem – Norton's theorem – Superposition theorems - Maximum power transfer theorem – solving networks using theorems- Wheatstone bridge - current through the galvanometer in an unbalanced Wheatstone's bridge – sensitivity of Wheatstone's bridge – end resistane problem in wheatstone bridge - Carey Foster's bridge – Calibration of Carey Foster's bridge – Kelvin's double bridge - Ballistic Galvanometer – its theory and damping correction – measurement of damping correction	10	
II	Transient Phenomena: growth and decay of charges in an LC circuit under dc bias - Growth and decay of current in an LR circuit under dc bias -time constant – CR and LCR circuits measurement of High resistance by leakage – mutual inductance between a pair of coils – self inductance by Rayleigh's bridge. AC CIRCUIT THEORY : AC quantities as vectors – LR, CR, LCR circuit under ac excitation – the phase relation between current and voltage- the way they are measured using an oscilloscope –	14	

	resonance circuits containing L, C and R in series and parallel, sharpness of resonance – Q factor of a coil, power in AC circuits and its measurement – AC bridges – Maxwell’s bridge – Schering bridge – De Sauty’s bridge – Anderson’s bridge.
References	<u>BOOKS FOR STUDY AND REFERENCE:</u> Electricity and magnetism – K.K. Tiwari, S. Chand and Co.,
	Unit I -Electricity and Magnetism by K.K. Tiwari.Pages: 769–790 of chapter 21; Pages: 311–323 of chapter 8;Pages: 344–353 of chapter 9,Electricity and Magnetism by Sehgal-Chopra-Sehgal Pages: 2.143–2.147 of chapter 5 Unit-II- Electricity and Magnetism by Sehgal-Chopra-Sehgal Pages: 2.278–2.298 of chapter 10 ,Electricity and Magnetism by K.K. Tiwari Pages: 453–456; 468–506 of chapter 11.Pages: 706–745 of chapter 16; 754–760 of chapter 17
Course Outcomes	On completion of the course, students should be able to do CO 1: be able to apply various network theorems to solve electrical and electronic circuits CO 2: be capable of making accurate measurement of small resistances

Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	2	2	-	1	2	2	2
CO2	3	-	-	2	3	-	2	2

$$\text{Mean} = 30 / 18 = 2.14$$

Semester	Sixth	Course Code	21PHYU06M3
Course Title	Optic Communication		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	35%
Category	Modular Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	<p>K-1: (Understand)</p> <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	<p>The Course aims to</p> <p>The course aims to introduce concepts on lasers, pulsed high power lasers and various gas, liquid and solid state lasers. Advanced topics like second harmonic generation and self focusing of light will be introduced. In addition the course will provide a knowledge of optical fibers, optical communication and different sources and detectors for the same.</p>		
UNIT	Content	No. of Hours	
I	Properties of laser light, different kinds of lasers -pulsed and continuous lasers- Ammonia maser, Gas lasers, Solid State Lasers, Dye Lasers, Semiconductor lasers - high power lasers - Q-Switching and mode locking: single mode and multimode lasers : Lamb Dip, mode locking of multimode lasers -, Non linear optics : electric polarization in materials – the effect of high electric field associated with the photons - Second Harmonic generation, Phase matching, Self-focusing of light.	10	
II	FIBRE OPTICS : Introduction – Nature of light, basic optical laws, total reflection of light – lossless propagation of light - optical fibre – different modes and configurations; Fibre types, Rays and modes, step index fibre structure, Ray-optics representation, wave representation, wave equation for step index fibres, model equation, Modes in Step-Index fibers, linearly polarized modes, Power flow in step-index fibres, single mode fibres – propagation modes, Graded-Index fibre structure – Numerical aperture and modes, Attenuation : absorption,	14	

	Scattering losses, bending losses, Core and Cladding losses, Fibre Optic cables – Fibre optic communication system and its advantages – Specific applications on Fiber Optics. – detectors and sources for fiber optic communication.
References	<p style="text-align: center;"><u>BOOKS FOR STUDY</u></p> <ol style="list-style-type: none"> Lasers and Non linear Optics, B.B. Laud, Wiley Eastern Ltd., New Delhi, 1992, Unit I Chapter 13: PP 178 – 218. Optical fibre communication, Gerd Keiser, McGraw Hill, International edns, New York 1991, Unit II Chapter 2, Chapter2 PP 16-59, 73 – 75, 85 – 96.
	<p style="text-align: center;"><u>BOOKS FOR REFERENCE</u></p> <ol style="list-style-type: none"> Optics, Ajoy Ghatak, Tata McGraw Hill, New Delhi, 1995. Lasers, Theory and Applications, A.K. Ghatak & K. Thiagarajan, Macmillan India Ltd., Delhi 1984
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: will have a sound knowledge of lasers</p> <p>CO 2: can understand and operate optical communication systems</p>

Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	-	-	1	-	2	2	2
CO2	3	-	2	-	-	2	2	2

Mean : 26/18 = 2.16

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Sixth	Course Code	21PHYU06M4
Course Title	Radiation Safety		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	50%
Category	Modular Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to The aim of this course is for awareness and understanding regarding radiation hazards and safety. The list of laboratory skills and experiments listed below the course are to be done in continuation of the topics.		
UNIT	Content	No. of Hours	
I	Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half-life, basic concept of alpha, beta and gamma decay,	10	

	<p>Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Disposal of Radioactive Waste: Origin and types of waste, classification of wastes and methods of disposal, disposal of short-lived solid, liquid and gaseous radioactive waste; disposal of animal carcasses and radioactive foliage, disposal limits for ground burial and sanitary sewage system, incineration, disposal of long-lived and in dispersible radioactive wastes.</p>	10
II	<p>Radiation detection and monitoring devices: Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose. (DAC). Radiation detection: Basic concept and working principles of gas detectors), Scintillation Detector (), Solid States Detectors and Neutron Detectors, Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil.</p>	10
References	<p>Experiments:</p> <ol style="list-style-type: none"> 1. Study the background radiation levels using Radiation meter Characteristics of Geiger Muller (GM) Counter: 2. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source). 3. Study of counting statistics using background radiation using GM counter. 4. Study of radiation in various materials (e.g. KSO₄ etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage. 5. Study of absorption of beta particles in Aluminum using GM counter. 6. Detection of a particles using reference source & determining its half life spark counter 7. Gamma spectrum of Gas Light mantle (Source of Thorium) 	

<u>BOOKS FOR REFERENCE</u>	
	1. W.E.Burcham and M. Jobes – Nuclear and Particle Physics - Longman (1995) 2. G.F.Knoll, Radiation detection and measurements. 3. Thermoluminescence Dosimetry, Mcknlly, A.F., Bristol, AdamHilger (Medical Physics Handbook 5) 4. W.J.Meredith and J.B.Massey, “Fundamental Physics ofRadiology”. John Wright and Sons, UK, 1989. 5. J.R.Greening, “Fundamentals of Radiation Dosimetry”, Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981. 6. Practical Applications of Radioactivity and Nuclear Radiation, G.C. Lowental and P.L.Airey, Cambridge University Press, U.K., 2001. 7. A.Martin and S.A. Harbisor, an Introduction to Radiation Protection, JohnWilley & Sons, Inc. New York, 1981.NCRP, ICRP, ICRU, IAEA, AERB Publications. 8. W.R. Hendee, “Medical Radiation Physics”, Year Book – Medical Publishers Inc. London, 1981.
Course Outcomes	On completion of the course, students should be able to do CO1: Can recognize different kinds of radiations. CO2: Will be capable of designing radiation protection mechanisms

Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	2	-	-	2	3	3
CO2	3	3	3	-	2	2	-	2

Mean = 31 / 18 = 2.58

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	Sixth	Course Code	21PHYU06M5
Course Title	Photovoltaics		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	100%
Category	Modular Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to <ul style="list-style-type: none"> • To understand the basic knowledge of solar energy systems • To cover the fundamental principles, design, and structure of PV modules. 		
UNIT	Content	No. of Hours	
I	Unit 1 : Basics of semiconductors - Photovoltaic Modules - History of solar PV cells, Design, and structure of PV module (mismatches in series/parallel connection), The technologies of a PV cell, power output I-V equation of PV module, I-V power curve of module, definition of solar irradiation and temperature	10	
II	Unit 2 :Components of a solar PV System: Basics of electrochemical cell, Definition: Batteries, batteries for PV system, factor affecting the battery performance, DC-DC/DC-AC energy converter, charge controller and MPPT.	14	

References	<p style="text-align: center;"><u>BOOKS FOR STUDY</u></p> <ol style="list-style-type: none"> 1. Antonio Luque and Steven Hegedus, Handbook of Photovoltaic Science and Engineering, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, ISBN 0-471-49196-9. 2. Solar Photovoltaic Cells: Photons to Electricity, Alexander P. Kirk. 3. Solar Cell Electricity Market History, Public Policy, Projected Future, and Estimated Costs (Pages: 17-42) 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: Define the basics of solar energy, Describe and understand electrodynamic basics</p> <p>CO2: Understanding the I-V equating and power cure of module</p>	

Semester	I / III	Course Code	21PHYU01A1/ 21PHYU03A1
Course Title	Allied Physics I		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	Allied Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	K-1: (Understand) <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to understand the basic concepts of acceleration due to gravity, determination and the factors affecting its values.		
UNIT	Content		No. of Hours
I	<p>ACCELERATION DUE TO GRAVITY AND GRAVITATION: Acceleration due to gravity-compound pendulum-interchangeability of centres of suspension and oscillation- determination of 'g' using a bar pendulum-determination of radius of gyration. Factors affecting the values of 'g' - effect of rotation - altitude - depth.</p> <p>Gravitation: Kepler's laws (No mathematical derivation) - Newton's law- density of Earth- mass of the Earth and the Sun- Gravitational Field-Gravitational Potential- Potential energy- Gravitational potential at a point distance 'r' from a body of mass-Gravitational potential outside a spherical shell and a solid sphere. Inertial and gravitational mass..</p>		12
II	<p>VISCOSITY AND SURFACE TENSION: Stream lined and turbulent motion – coefficient of Viscosity – Poiseuille’s flow – Experimental determination of coefficient of viscosity – motion in a viscous medium – Stoke’s law – comparison of viscosities – Ostwald Viscometer. Surface tension – Explanation – surface film</p>		10

	and surface energy – Free energy of a surface – Excess of pressure inside the drops and bubbles – Rise of a liquid in a capillary tube – Experimental determination of surface tension – Jaeger’s method, Drop weight method and capillary rise method.	
III	Thermodynamics Zeroth and I Law of Thermodynamics – II law of Thermodynamics – Carnot’s engine and Carnot’s cycle – Efficiency of a Carnot’s Engine – Entropy – Change in Entropy in Reversible and Irreversible Process – Change in entropy of a perfect gas – Change in Entropy when Ice is converted into steam.	10
IV	Interference – Definition - Condition for interference – Coherence condition – coherent sources - Young’s Double - slit experiment – Fresnel biprism – Bi- mirror – Lloyd’s single mirror – Fringes with white light – Colours of thin films . Diffraction condition – Diffraction by circular aperture - Grating	10
V	Polarisation – Reflection and Refraction – Brewster’s law – Double refraction – Nicol prism and its uses – Rotation of plane of polarization – specific rotatory power and saccharimetry.	6
References	<p><u>BOOKS FOR STUDY</u></p> <ol style="list-style-type: none"> 1. Elements of Properties of matter - D.S. Mathur 2. Fundamentals of Optics - Khanna and Gulati 3. A text book on Sound - Khanna and Bedi 4. Optics - Ajoy Ghatak 5. A text book of Optics- Subrahmanyam and Brij Lal 6. A text book of Sound - Subrahmanyam and Brij Lal 7. Properties of Matter- Subrahmanyam and Brij Lal 	
	<p><u>BOOKS FOR REFERENCE</u></p> <p>Physics – V Edition. Volume I David Halliday, Robert Resnick – Jearl Walker – Asian Books,</p>	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO 1: understand the basic concepts of acceleration due to gravity, determination and the factors affecting its values.</p> <p>CO 2: Learn the Kepler's laws of planetary motion and determine the mass & density of the Earth and Sun</p> <p>CO 3: Basics of ultrasonic production , measurement and application</p> <p>CO 4: apply the principle of interference in forming Newton's ring and test the</p>	

	<p>paleness by air wedge method</p> <p>CO 5: explain the principle of polarization and apply the principle to optical applications.</p>
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Mapping of COs with PSOs:

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	1	-	2	-	2	1
CO2	3	2	1	-	1	-	2	2
CO3	3	1	1	-	1	-	2	1
CO4	3	2	1	-	3	1	2	2
CO5	3	1	1	-	3	-	2	1

Mean = 62/45= 1.722

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	I / III	Course Code	21PHYU02A3 /21PHYU04A3
Course Title	Allied Physics Practical		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Allied Course		
Scope of the Course	<ul style="list-style-type: none"> • Basic Skill / Advanced Skill • Skill Development 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1: (Understand) • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to Basic knowledge about measuring instruments		
UNIT	Content	No. of Hours	
I	<ol style="list-style-type: none"> 1. Measuring instruments – Vernier caliper , Screw gauge , Vernier microscope 2. Single optic lever – measurements of thickness. 3. Surface tension – capillary rise method. 4. Viscosity – Poiseuille’s method. 5. Bending of beams – cantilever, uniform and non-uniform bending. 6. Newton’s law of cooling- verification, specific heat of liquid. 7. Specific heat of solid/ liquid method of mixture. 8. Lee’s disc experiment – thermal conductivity of poor conductor. 9. Joule’s law – specific heat of liquid. 10. Comparison of magnetic moments – field aiding, field opposing. 11. Meter bridge – resistance of coil, specific resistance. 12. Figure of merit of table galvanometer. 13. Focal length of long focus convex lens, concave lens. 14. Spectrometer – refractive of prism and liquid. 15. Compound pendulum – determination of g and radius of gyration. 16. Diode characteristics 17. Transistor characteristics. 		

Semester	Second / Fourth	Course Code	21PHYU02A2/ 21PHYU04A2
Course Title	Allied Physics II		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Allied Course		
Scope of the Course	<ul style="list-style-type: none"> • . Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship 		
Cognitive Levels addressed by the Course	<p>K-1: (Understand)</p> <ul style="list-style-type: none"> • K-2: (Apply) • K-3: (Analyze) 		
Course Objectives (Maximum: 5)	The Course aims to the student should be able to gain enough knowledge to effectively learn the subjects in which they will be majoring		
UNIT	Content		No. of Hours
I	<p>DC AND AC CIRCUITS: DC CIRCUITS: Kirchoff's law on voltages and currents – maximum power transfer theorem Wheatstone's bridge – Carey Foster's bridge – capacitors action, parallel plate and cylindrical capacitors – parallel and series connection of capacitors – energy stored in capacitors AC CIRCUITS: Peak, mean and rms values of ac – relation between current and voltage in capacitors and inductors – transformers: reflected impedance, losses in transformers – RC , LR circuits, and LCR circuits.</p>		12
II	<p>ANALOG AND DIGITAL ELECTRONICS: Semiconductor electronics – Diode– Zener diode – Half and Full wave rectifiers – ideas of filters – Transistors – biasing of a transistor – input and output characteristics – Feed back both positive (oscillator) and negative (amplifier) Logic gates AND ,</p>		10

	OR , NOT ,NAND and NOR using discrete components – EX-OR Gate – solving Boolean equations using laws and theorems.	
III	Particle properties of waves – Black body radiation – Photoelectric effect – Compton effect – de Broglie wave – phase and group velocities – wave nature of X– ray– Diffraction of X – ray by crystal – Bragg's Law – Vector atom model – fine structure of Hydrogen spectrum – Pauli's exclusion principle – Stern and Gerlack experiment.	10
IV	Becquerel rays – laws of radioactivity – decay constant– half life – mean life – carbon dating – age of the application of radioisotopes in medicine and agricultural – accelerators – linear accelerators– cyclotron – synchro cyclotron – detector– ionization chamber – G.M. Counter.	10
V	Lasers: Introduction- normal emission – absorption - stimulated emission – spontaneous emission – Population inversion- Einstein coefficients – Light amplification – Threshold condition– Cavity resonator – Pumping – Ruby – He – Ne – Dye laser and diode laser –Basic ideas on optical communication – Optical fiber and types – Losses – Sources anddetectors – Laser application in medicine, industry and metrology.	6
References	<p><u>BOOKS FOR STUDY AND REFERENCE:</u></p> <ol style="list-style-type: none"> 1. Electricity and Magnetism with Electronics – K.K. Tiwari. 2. Concepts of Modern Physics, Arthur Beiser Tata McGraw Hill Co 3. Atomic Physics, J.B.Rajam, S.Chand Co 4. Modern Physics – Seghal, Chopra, Seghal, S. Chand, New Delhi. 5. Basic electronics and linear circuits – Bhargava Kulshreshtha and Gupta – TTTI Publications, Chandigarh 6. Digital Principles – Malvino and Leach, McGraw Hill.Nuclear physics by D.C. Dhayal (Himalaya Publishing House-Fifth revised & enlarged edition. 	
Course Outcomes	<p>On completion of the course, students should be able to do</p> <p>CO1: understand and apply AC and DC circuits.</p> <p>CO2: design simple power supplies</p> <p>CO3: apply logic gates for implementation of logical circuits</p> <p>CO4: understand the particle wave duality</p> <p>CO5: apply radio isotopes for specific applications like agriculture and medicine</p>	

Mapping of COs with PSOs:

CO \ PSO	PSO							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	1	3	2	2	3	2	1	1
CO2	-	3	2	3	3	1	2	1
CO3	-	3	2	2	3	1	1	2
CO4	3	-	2	-	-	-	-	2
CO5	3	3	1	-	1	3	3	3

Mean = 80/ 45 = 2.16

Strongly Correlated (S)	3 marks
Moderately Correlated (M)	2 marks
Weakly Correlated (W)	1 mark
No Correlation (N)	0 mark
Note: No course can have "0" (Zero) score	

Semester	FIRST	Course Code	21PHYUVAC1
CourseTitle	SOLAR PV PANEL INSTALLATION AND MAINTENANCE		
No.ofCredits	2	No.ofcontacthoursperWeek	2
NewCourse/RevisedCourse	NewCourse	Ifrevised,PercentageofRevisioneffected (Minimum20%)	
Category	Value added Programme		
ScopeoftheCourse(maybemorethanone)	<ul style="list-style-type: none"> • BasicSkill/AdvancedSkill • SkillDevelopment • Employability • Entrepreneurship • Value-Added Courses imparting transferable and lifeskills • Field Placement/FieldProject • Internship 		
Cognitive LevelsaddressedbytheCourse	<ul style="list-style-type: none"> • K-1:(Remember) • K-2:(Understand) • K-3:(Apply) • K-4:(Analyze) • K-5:(Evaluate) • K-6:(Create) 		
Course Objectives(Maximum:5)	<p>TheCourseaimsto</p> <ul style="list-style-type: none"> • Impart knowledge on the basics of PV panel • Train the students on installation of solar PV panel • Give awareness on the maintenance and safety 		
UNIT	Content	No.ofHours	
I	UNIT - I: SOLAR PANEL SYSTEM AND INSTALLATION Photovoltaic Solar Panels - Electrical Power System - Solar PV Modules - PV Panel components Responsibilities of a Solar Panel Installation Technician - Prerequisites for Solar Panel Installation - Site Analysis - Installation and Maintenance of Solar Panel - Work Ethics - Workplace Safety - Soft Skills - Assessing site conditions - installation requirement - quality of material and handling - tools used. PV Circuit Fundamentals - Sample System Designs - Power and PV Panel calculation - One-Line Electrical Diagrams - Mechanical Installation: Rooftop - Mechanical Installation: Ground-Mount	16	

II	<p>ELECTRICAL INSTALLATION, TESTING AND TROUBLE SHOOTING</p> <p>Batteries in a PV System - Study of Charge Controllers - Study of Inverters - Mounting Structures - Tracking mechanisms - Off-Grid System Installation - On Grid System Installation. Trouble Shooting of different PV system - Commissioning and Testing of Solar Power Plant - O & M of Solar Power Plant - Grid Integration and System - Jawaharlal Nehru National Solar Mission - MNRE guidelines - DPR preparation for power plants - Visit to a solar power plant.</p>	16
	<p>ReferenceBooks:</p> <p>Joseph Burdick and Philip Schmidt, “Install your own solar panels designing and installation”, eBook version 1.0, 2017.</p> <p>Mike Sullivan, “Solar Rooftop DIY”, The Countryman Press, 2016.</p> <p>E-Resources(URLsofe-books/YouTubevideos/onlinelearningresources,etc.)</p> <ol style="list-style-type: none"> 1. (https://www.greenmatch.co.uk/blog/2014/09/solar-panel-installation-and-maintenance) 2. https://solar-to-the-people.com/solar-installation-solar-maintenance/ 3. https://merculexenergy.com/design-installation-and-maintenance-of-solar-pv-systems/ 	
CourseOutcomes	<p>On completion of the course, students should be able to</p> <p>CO-1 Acquire the knowledge about basics of electric and solar energy, and understand the solar PV system.</p> <p>CO-2 Predict the need of solar power and solve this by installing PV system.</p> <p>CO-3 Compare different installation techniques, implement the PV technique for suitable places.</p> <p>CO-4 Examine and the efficiency of PV system and compose a suitable system for the required power.</p> <p>CO-5 Categorize the work ethics and work place safety, recommend the techniques to construct the PV system and design and construct the solar PV system to power a house.</p>	

Semester	SECOND	CourseCode	21PHYUVAC2
CourseTitle	NON-DESTRUCTIVE TESTING		
No.ofCredits	2	No.ofcontacthoursperWeek	2
NewCourse/RevisedCourse	NewCourse	Ifrevised,PercentageofRevisioneffected (Minimum20%)	
Category	Value added Programme		
ScopeoftheCourse(maybe morethanone)	<ul style="list-style-type: none"> • BasicSkill/AdvancedSkill • SkillDevelopment • Employability • Entrepreneurship • Value-Added Courses imparting transferable and lifeskills • Field Placement / FieldProject • Internship 		
Cognitive LevelsaddressedbytheCourse	<ul style="list-style-type: none"> • K-1:(Remember) • K-2:(Understand) • K-3:(Apply) • K-4:(Analyze) • K-5:(Evaluate) • K-6:(Create) 		
Course Objectives(Maximum:5)	<p>TheCourseaimsto</p> <ul style="list-style-type: none"> • Understanding to Use modern tools to examine flaw in the materials. 		
UNIT	Content	No.ofHours	
I	<p>VISUAL INSPECTION AND ACOUSTIC EMISSION TESTING</p> <p>Fundamentals - Test object characteristics -Temperature indicating devices and materials - Determination of dimensions. Instrumentation and Signal Processing - Cables - Signal Conditioning - Signal Detection - Source Location Techniques - Acoustic emission test systems-Techniques -Applications</p> <p>THERMOGRAPHY AND ELECTROMAGNETIC TESTING : Principles/Theory - The nature of heat and heat flow-Temperature measurement principles-Proper selection of Thermal/Infrared testing-Friction investigations-Thermal capacitance investigations - Interpretation - Remote Field Testing (RFT) Principles & Theories- Principles and Theory-Equipment and Materials-Interpretation and Evaluation of Signals-Procedures.</p>	(16 Hrs)	

II	<p>LEAK TESTING AND LIQUID PENETRANT TESTING</p> <p>Physical principles in leak testing-Detector/instrument performance factors-Pressure change/measurement test-Leak interpretation evaluation- Principles of liquid penetrant process-Equipment/Materials-Testing and maintenance of materials- Interpretation- Factor affecting indications-Indications from discontinuities-Relevant and Non-relevant indications-Liquid penetrant testing procedures .</p> <p>RADIOGRAPHIC TESTING AND ULTRASONIC TESTING: Radiation Detectors-Techniques-Radiographic Techniques- Operational and emergency procedures – Ultrasonic testing Techniques-Remote Monitoring - Variables affecting test results - Evaluation - Procedures-Specific Applications-Codes - Safety and Health.</p>	(16 Hrs)
	<p style="text-align: center;">ReferenceBooks:</p> <p>3. Dr. BaldevRaj, Jayakumar and M. Thavasimuthu, “Practical Non-Destructive testing”, Narosa Publications, New Delhi, 2009.</p> <p style="text-align: center;">E-Resources(URLsofe-books/YouTubevideos/onlinelearningresources,etc.)</p> <ol style="list-style-type: none"> 1. (https://www.flyability.com/ndt) 2. https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx 3. https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx 	
CourseOutcomes	<p>On completion of the course, students should be able to</p> <p>CO-1 Describe and discuss different NDT techniques as per requirements.</p> <p>CO-2 Use modern tools to examine flaw in the materials.</p> <p>CO-3 Solve various manufacturing defects by comparing the results of tests.</p> <p>CO-4 Apply accurate testing method for materials using NDT.</p> <p>CO-5 Examine and explain environment friendly solutions to achieve organizational sustainability with ethical values.</p>	

Semester	THIRD	CourseCode	21PHYUVAC3
Course Title	ELECTRICAL WIRING AND TROUBLE SHOOTING		
No. of Credits	2	No. of contact hours per Week	2
New Course /Revised Course	New Course	If revised, Percentage of Revision effected (Minimum 20%)	
Category	Value added Programme		
Scope of the Course (maybe more than one)	<ul style="list-style-type: none"> • Basic Skill/Advanced Skill • Skill Development • Employability • Entrepreneurship • Value-Added Courses imparting transferable and life skills • Field Placement / Field Project • Internship 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1:(Remember) • K-2:(Understand) • K-3:(Apply) • K-4:(Analyze) • K-5:(Evaluate) • K-6:(Create) 		
Course Objectives(Maximum:5)	<p>The Course aims to</p> <ul style="list-style-type: none"> • Acquire the knowledge and understand the basics of electricity, electrical components and wiring methods and troubleshooting. 		
UNIT	Content	No. of Hours	
I	(UNIT - I: BASICS OF ELECTRICITY AND ELECTRICAL COMPONENTS Electricity and generation - Electrical Terms - Electrical Circuits - Grounding and Polarization - Home wiring Tools - Power Station and Substation - IEE Rules - Safety and precautions. Wire and Cable - Conduit - Boxes - Panels - Switches - Sockets - control switches - MCB - ELCB - RCD - GFCI and AFCI Breakers - House Surge Arrestors - Service Panels.	(12Hrs)	
II	HOUSE WIRING AND TROUBLE SHOOTING Household Circuits - Single Phase wiring - Three Phase Wiring -	(20Hrs)	

	<p>Open and Concealed wiring - Grounding and Bonding a wire system - Lights - Motor - Fans - wiring a room - wiring a kitchen - Staircase Wiring.Types of Panels - panel diagrams - circuit breakers - switches on the panel - Emergency Shut Down reset - PLC wiring - control panel components - Connections and routing - Conductor and cable runs - EMC compliant panel - layout of equipment in a panel - reference regulations and standards.Electrical faults - main board - distribution board - socket, plug and cord - Light fixtures - LED lamps - Ceiling Fans - Heater.</p>	
<p>References</p>	<p style="text-align: center;">ReferenceBooks:</p> <ol style="list-style-type: none"> 1. (Black Decker, “The complete guide to wiring”, Updated 7th Edition, Quarto Publishing Group USA, 2018. 2. Ray C. Mullin, Phil Simmons, “Electrical Wiring Residential”, 17th Edition, Delmar, Cengage Learning, 2012. <p style="text-align: center;">E-Resources(URLsofe-books/YouTubevideos/onlinelearningresources,etc.)</p> <ol style="list-style-type: none"> 1. https://www.hplindia.com/wire-cables/domestic-wires.php 2. https://www.contractorbhai.com/basics-of-how-your-home-electrical-works/ 3. https://www.primecabindia.com/all-about-house-electrical-wiring-system-a-small-guide 	
<p>CourseOutcomes</p>	<p>On completion of the course, students should be able to</p> <p>CO-1 Acquire the knowledge and understand the basics of electricity, electrical components and wiring methods and troubleshooting.</p> <p>CO-2 Classify various electrical components and its applications.</p> <p>CO-3 Identify and assess the need, design and wire the panel</p> <p>CO-4 Illustrate and explain the wiring circuits.</p>	

Semester	FOURTH	Course Code	21PHYUVAC4
Course Title	RENEWABLE ENERGY PHYSICS		
No.of Credits	2	No.of contact hours per Week	2
New Course /Revised Course	New Course	If revised, Percentage of Revision effected (Minimum20%)	
Category	Value added Programme		
Scope of the Course (maybe more than one)	<ul style="list-style-type: none"> • Basic Skill/Advanced Skill • Skill Development • Employability • Entrepreneurship • Value-Added Courses imparting transferable and lifeskills • Field Placement / Field Project • Internship 		
Cognitive Levels addressed by the Course	<ul style="list-style-type: none"> • K-1:(Remember) • K-2:(Understand) • K-3:(Apply) • K-4:(Analyze) • K-5:(Evaluate) • K-6:(Create) 		
Course Objectives(Maximum:5)	<p style="text-align: center;">The Course aims to</p> <p>Understand the importance of energy to the society Acquire knowledge on wind, solar energy and their utilization.</p>		
UNIT	Content	No.ofHours	
I	<p>WIND POWER AND HYDRO POWER</p> <p>Historical uses-Wind characteristics and resources-Power transfer to a Turbine-Turbine types and terms-Controlling and optimizing wind turbine performance-Electrical aspects and grid integration-Small wind-Offshore wind-Environmental impacts-Unusual design and applications.</p> <p>Hydro power-Wave, Tidal and Ocean thermal power resources-Introduction to tidal power and cause of the tides-Ocean thermal energy conversion-Social and environmental impacts of hydro power.</p>	(16 Hrs)	

II	<p align="center">PHOTOVOLTAICS AND ENERGY CONVERSION AND EFFICIENCY</p> <p>Conductors, Insulators and semiconductors-Increasing the conductivity of semiconductors through doping- PN junction- Generic photovoltaic cell-Electrical property of a solar cell-Efficiency of solar cells and solar system-Grid connection and inverters-Other types of solar cells.</p> <p>Factors besides efficiency influencing energy related choices-Lowest of the low hanging fruit-Obstacles to efficiency and conversion-Problems.</p>	(16 Hrs)																								
References	<p align="center">Text Books (with chapter number & page number, wherever needed):</p> <p>1. (Robert Ehrlich, Renewable energy: A first course, CRC press, by Taylor & Francis Group, LLC, 2013.</p> <table border="0" data-bbox="574 785 1159 999"> <thead> <tr> <th>UNIT</th> <th>BOOK</th> <th>CHAPTERS</th> <th>SECTIONS</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1.2-1.9, 1.13-1.15</td> </tr> <tr> <td>2</td> <td>1</td> <td>7</td> <td>7.1-7.10</td> </tr> <tr> <td>3</td> <td>1</td> <td>8</td> <td>8.1-8.5</td> </tr> <tr> <td>4</td> <td>1</td> <td>11</td> <td>11.2-11.11</td> </tr> <tr> <td>5</td> <td>1</td> <td>12</td> <td>12.2-12.5</td> </tr> </tbody> </table> <p align="center">For problems: Page no: 369</p>		UNIT	BOOK	CHAPTERS	SECTIONS	1	1	1	1.2-1.9, 1.13-1.15	2	1	7	7.1-7.10	3	1	8	8.1-8.5	4	1	11	11.2-11.11	5	1	12	12.2-12.5
UNIT	BOOK	CHAPTERS	SECTIONS																							
1	1	1	1.2-1.9, 1.13-1.15																							
2	1	7	7.1-7.10																							
3	1	8	8.1-8.5																							
4	1	11	11.2-11.11																							
5	1	12	12.2-12.5																							
Course Outcomes	<p>On completion of the course, students should be able to</p> <p>CO-1 Understand the importance of energy to the society</p> <p>CO-2 Acquire knowledge on wind, solar energy and their utilization</p> <p>CO-3 Recall and infer the hydro power and the photovoltaic solar energy</p> <p>CO-4 Acquire knowledge on energy conversion and efficiency of solar cells</p> <p>CO-5 Analysis the solar photovoltaic system and the solar efficiency</p>																									