B.Sc. PHYSICS

SYLLABUS

(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

Annexure – III

SCHEME OF THE PROGRAMME

OBE Elements for B.Sc. (Physics) Programme

Programme Educational Objectives (PEO)

PEO 1: To make the students proficient in the subject of Physics from the basics to advanced level.
PEO 2: To use the knowledge gained to devise experiments and to get a better understanding of the physical world.
PEO 3: To use the knowledge of Physics for going towards higher education or career plan.
PEO 4: To use the knowledge of Physics for the self development and create sustainable environment.
PEO 5: To apply innovative ideas for the development of low cost instruments to cater the social needs.
PEO 6: To enable the students to practice physics at home and at the work place.

Program Outcome (PO)

On completion of the B.Sc. Physics Programme, the graduate will:

PO 1: Become knowledgeable in the subject of Physics.
PO 2: Be capable of applying the knowledge gained to suit the requirements of the Employer / Institution / Enterprise / Society.
PO 3: Apply the skills in the area of Applied Physics.
PO 4: Use the acquired knowledge to bring – in visible changes in the quality of life.
PO 5: Adopt and adapt the Physics principles to solve societal and national problems.
PO 6: Manage energy crisis through new and renewable energy sources.
PO 7: Blend with the society with a high degree of professional ethics, community living and Nation Building initiatives

PROGRAMME SPECIFIC OUTCOME (PSO)

On completion of the B.Sc., Physics Programme, the graduates will be capable of:

PSO 1: Identifying the principles behind the phenomena exhibited by nature.
PSO 2: Solving the problems in the field of applied Physics with the understanding of the knowledge gained.
PSO 3: Establishing mathematical relations for the phenomena and solve them.
PSO 4 : Fabricating and servicing simple gadgets
PSO 5: Designing experiments and analyzing the outcome of the same.
PSO 6: Adopt and adapt the Physics principles to solve societal and national problems.
PSO 7: Disseminating knowledge to stakeholders
PSO 8: Competing with their peer group towards their personal progress in the scientific arena.
PSO 9: Developing scientific temper.

B.Sc., (Physics)
(For the batches joining in 2021– 2022 and afterwards)

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

Scheme of the Programme

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
		21ENGU01X1	English	Language II	3	3
		21NSSU0001/ 21FATU0001/ 21SPOU0001	NSS/ Fine Arts/ Sports	Foundation Course	1	1
		21PEYU0001	Yoga	Foundation Course	1	1
		21EVSU0001	Environmental Science	Environmental Science	3+1	4
		21PHYU0101	Mechanics and Properties of Matter	Core Course	3	3
		21PHYU0102	Practical – I	Core Course	1	3
		21MATU01A1	Allied Mathematics I	Allied Course	4	4
		21PHYUVAC1	**Renewable Energy Physics**	**Value added Course**	**2***	
				Total	**20**	
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	2
		21GTPU0001	Gandhi's Life, Thought and Work	Foundation Course	2	2
		21EXNU0001	Extension Education	Foundation Course	2	2
		21ENGU00C1	Communication and Soft Skills	Soft Skills	2	2
		21PHYU0203	Optics	Core Course	3	3
		21PHYU0204	Practical – II		1	3
		21MATU02A2	Allied Mathematics – II	Allied Course	4	4
		21PHYUVAC2	**Solar PV Panel and Installationand Maintenance**	**Value Added Course**	**2***	
				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	2
		21SHSU0001	Shanthi Sena	Part V	1	2
		21CSAU03C1	Python Programming and Its Application in Physics	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	–
		21PHYUVAC3	**Electrical Wiring and Trouble Shooting**	**Value Added Course**	**2***	
				Total	**24**	
4	**IV**	21PHYU0407	Analog and Digital Electronics	Core Course	4	4
		21PHYU0408	Atomic Physics and Lasers		4	4
		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
		21PHYU03F2	Extension and Field Visit	Compulsory Non Credit Course	1	2
		21PHYU04HE	Human Ethics		1	
		21PHYUVAC4	**Non – Destructive Testing**	**Value Added Course**	**2***	
				Total	**24**	
5	**V**	21PHYU0511	Electromagnetics	Core Course	4	4
		21PHYU0512	Nuclear and Particle Physics/		3	3
		21PHYU0513	Classical Mechanics and Relativity		4	4
		21PHYU0514	Practical – V		2	6
		21PHYU05EX	Discipline Centric Elective II	Discipline Centric Elective	3	3
			Generic Elective II	Generic Elective	3	3
		21PHYU05S1	Instruments and Servicing	Skill Based Elective	2	2
				Total	**21**	
6	**VI**	21PHYU0615	Solid State Physics	Core Course	3	3
		21PHYU0616	Quantum Mechanics		4	4
		21PHYU0617	Spectroscopy		4	4
		21PHYU0618	Practical – VI		2	6
		21PHYU0619	Project (CFA40+External40+Viva20)		0 + 4	
		21PHYU06MX 21PHYU06MX	Modular Course I Modular Course II	Generic Elective SRS (Any 2 Modules)	2 2	4
Total					**21**	
Grand Total					**132**	

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

21PHYU04D1	Solar Thermal and 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 and 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 and Renewable Energy Systems
21PHYU04G2	Physics of Sports
21PHYU04G3	Physics of Sound and Acoustics

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

21PHYU05G4	Instruments and Servicing
21PHYU05G5	Agricultural Physics
21PHYU05G6	Physics of Crystals

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

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

Courses offered to the other Departments:

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

List of Value Added Courses

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

*** Value added courses credits**

Semester	I	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	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. To impart knowledge about linear and rotational motion of bodies and gravitational forces among bodies. 2. To make them understand the principles and methods of finding the bulk properties of structural materials.		

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	**On completion of the course, students should be able to do** CO1: Specify the principles and types of collision between the bodies. CO2: State the Newton's second law and conservation of Angular momentum. CO3: Estimate the gravitational force near and inside the earth surface and the energy of satellites CO4: Design experiments to find the Young's modulus and rigidity modulus of building materials. CO5: Discuss the principle of flow of liquids and its applications in daily life.	
Reference	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. 2. Elements of properties of matter, – D.S. Mathur, Chapter 10, 11 and 12and chapter 21. Reprinted in 1984, S. Chand & Co., New Delhi. Relevant section of XII & XIII and related problems. 3. Concept of physics H.C.Verma, Bharati Bhawan publishers and distributors (2015).	

Mapping of COs with PSOs:

PSO / CO	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	I	Course Code	**21PHYU0102**
Course Title	**Practical – I**		
No. of Credits	1	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revisioneffected **(Minimum 20%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. To familiarize and make the students acquire knowledge and skills through basic Measuring instruments and measurement techniques.		

UNIT	Content	No. of Hours
I	1. Basic Measurement Techniques, Errors of observation, Data Representation and Analysis 1. Vernier calipers and Vernier Microscope 2. Single Optic level and Screw gauge 3. Measurement of length / a dimension using 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. 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 lower temperature method of reducing random errors.	

	d. Systematic Errors in observation due to 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 temperatureand higher temperature. 5. Method of reducing Systematic. Estimation of errors of observation. c. In a single measurement d. In several measurement of the same quantity 1. Estimation of standard deviation 2. Effect of the number of readings on standard deviation. 5. Generation of linear and nonlinear data and graphical representation a. Extension of a spring b. Water flowing through a burette or cooling of a hot body. 6. Least square fit, arriving at empirical relations from an examination of the graph. 7. Study of Motion of a compound pendulum. 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 8. Surface tension – Interfacial tension. 9. Coefficient of viscosity.	

Semester	II	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%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. To acquire knowledge on few basic physics optical phenomena and their corresponding theoretical aspects.		

UNIT	Content	No. of Hours
I	**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.	12
II	**INTERFERENCE/INTERFEROMETRY:** Analytical treatment interference – theory of interference fringes – interference in thin films due to reflected light – Air wedge – 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 – Gehrcke plate – Jamins' – Raylegh's refractometer.	**10**

III	**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 – Limit of resolution and resolving power– Rayleigh Criterion for resolution – Resolving power of a plane diffraction grating and prism – Fresnel wave front andtheory of half period zones – zone plate – comparison with convex lens – comparison between Fresnel and fraunhofer diffraction.	**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 – HalfShade device .	**10**
V	**OPTICAL INSTRUMENTS:** Microscopes – Simple Microscope (Magnifying glass) – compound Microscope – Ultra Microscope – Eyepieces – Huygen's Eyepiece – Ramsden's Eyepiese – Comparison of Eyepieces – Telescope – Refracting astronomical telescope – Abbe Refractometer – Ulrich refractometer – Photographic Camera – Prism binoculars.	**6**
Course Outcomes	**On completion of the course, students should be able to do** 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 Raylegh'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.	
Reference	**Text Books:** Dr.N. Subramaniyam, Brijlal and Dr.M.N. Avathanilu, Optics,S. Chand&Co, Pvt.Lted.25th revised edition, New Delhi, 2012. **BOOKS FOR REFERENCE:** Optics – Ajoy Ghatak, 2nd Edition, Tata McGraw Hill Pub. Copy. Ltd., NewDelhi, 1992. Introduction to Classical and Modern Optics– J.R. Meyer Arendt– 2nd edition– PHI, 1984. Fundamentals of Physics – V Edn. David Halliday, Robert Resnick andK.S.Krane–john Wiley & Sons New Delhi (2014) Relevant section of Chapter– 19.	

Mapping of COs with PSOs:

PSO / CO	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

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	II	Course Code	**21PHYU0204**
Course Title	**Practical – II**		
No. of Credits	1	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revisioneffected **(Minimum 20%)**	20%
Category	**Practical**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. 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	1. Study of depression and deflection of a cantilever. 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	III	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 Revisioneffected **(Minimum 20%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The fundamental concepts on Thermal Physics is being exposed under various angles		

UNIT	Content	No. of Hours
I	**UNIT – I**: Kinetic theory of gases– Introduction – Pressure exerted by a gas – Deduction of gas laws on the basis of kinetic theory – Maxwell's law of velocity distribution – Calculation of RMS speed – most probable speed – average speed – Maxwell – Boltzmann law of velocity distribution– Degrees of freedom – Vibratory motion of molecules – Internal energy of a gas – Law of equi – partition of energy – Mean free path– 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 & Second law of thermodynamics – Introduction – Zeroth law of thermodynamics – Work done in a (i) Non– cyclic process – (ii) Cyclic process (iii) Isothermal process (iv) Adiabatic process (v) Isobaric process (vi) Isochoric process – Concept of point and path functions – Internal energy –First law of thermodynamics – Relation connecting P,V and T in an adiabatic process – Application of first law of thermodynamics to the specific heat – Second law of thermodynamics – Clausius and Kelvin – Planck statement of the second law – Heat engine Carnot theorem – Refrigerator .	11

IV	**UNIT – IV**: Thermodynamic scale of temperature – Applications of Second law of thermodynamics – Clausius – Clapeyron equation –Other thermodynamic work cycles – Rankine cycle – Otto cycle –Diesel cycle – Expressions for their efficiency – Heat engines in actual practice – Steam engine –Otto engine–Diesel engine – Zero point energy.	8
V	**UNIT – V** : Entropy– Introduction – Definition of entropy – Entropy and adiabatics – Change of entropy in any reversible and irreversible cycle –Expression connecting two laws of thermodynamics – Entropy of a perfect gas – Entropy changes in simple reversible processes – T– S diagram – Thermodynamic functions – Internal energy – Enthalpy – Helmholtz function – Gibbs function – Maxwell's thermodynamic relations – TdS equations – Application – Joule – Kelvin coefficient.	10
Course Outcomes	**On completion of the course, students should be able to do** **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	
Reference	**Text Books:** Heat and Thermodynamics by D.S. Mathur, Sultan Chand & Sons Educational publishers, New Delhi, Fifth Edition Unit I : Chapter 6: 207, 3 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.	

Reference	**BOOKS FOR REFERENCE:** 1. Heat and 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, Indianstudent'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.
	Related online courses – MOOC courses: https://www.edx.org/course/basics– transport– phenomena– delftx– tp101x– 2https://www.edx.org/course/thermodynamics– tbombayx– me209– 1x– 1

Mapping of COs with PSOs:

PSO / CO	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	III	Course Code	**21PHYU0306**
Course Title	**Practical – III**		
No. of Credits	1	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revisioneffected **(Minimum 20%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. To expose the measurement on electricity and advanced measurementon optics areas has been exposed		

UNIT	Content	No. of Hours
I	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. a. Verification of Brewster's law b. Study of rotatory power of materials – Laurent's half shade polarimeter. 5. Familarisation 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 range voltmeter 9. Potentiometer – measurement of medium and high voltages – calibration of medium and high range voltmeters 10. Potentiometer – measurement of current – calibration of ammeter.	

Semester	IV	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 Revisioneffected **(Minimum 20%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The student will be able to design simple electronic circuits for the laboratory andhome with the help of knowledge gained through this course.		

UNIT	Content	No. of Hours
I	**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 and CC – transistor characteristics in CE configuration – relation between alpha and beta – comparison between the three configurations – reasons for the choice of CE configuration – basic CE amplifier – FET– construction – working and characteristics – single stage transistor amplifier – graphical method – calculation of gain – hybrid parameters – simplified model – amplifier analysis – Calculation of gain – input and output impedances.	13
II	**UNIT – II: MULTISTAGE AMPLIFIERS:** Gain of a multistage amplifier – decibel – coupling of two stages – RC coupling transformer coupling– frequency response of an RC coupled amplifier – bandwidth of an amplifier FEEDBACK AMPLIFIER – Concept of feedback – types of feedback voltage gain with feedback – advantages of negative feedback – Oscillators – positive feedback amplifier as an oscillator – Hartley oscillator and Colpit's oscillator (no detailed derivation).	13
III	**UNIT – III**: **OPAMP**: General features – Virtual ground – inverting amplifier – non– inverting amplifier – voltage follower – 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 – half and full adders – half and full subtractors – Boolean laws and theorems – Boolean relation for OR and AND operations – duality theorem – 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.	13
V	**UNIT – V: FLIP FLOPS AND COUNTERS:** RS flip flops – clocked RS flip flop – D flip flop – edge triggered D flipflop – JK flip flop – JK master slave – Synchronous and asynchronous counters – 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.	12
Course Outcomes	**On completion of the course, students should be able to do** **CO 1**: Will become capable of analyzing and measuring different parameters related to transistor **CO 2**: Will be able to measure the gain and band width **CO 3**: Will be capable of designing oscillator **CO 4**: Will be able to design Op– amp based circuits and implement to simple instruments **CO 5**: Will be aware of methods to reduce logical circuits and implement them.	
Reference	**Text Books:** 1. Bhargava NN, Kulshreshta DC and Gupta SC, Basic electronics and linear circuits,Tata McGraw Hill (1984), Unit I: Chapter 5, page 126– 161,168– 173, Chapter 8, page 261– 278 Unit II: Chapter 9, 302– 320, Chapter 12, page 390– 402 and Chapter 13, page 413– 424. 2. Jacob Millman, Microelectronics: Digital and Analog Circuits and Systems, McGraw Hill, Singapore (1979). Unit III: Chapter 16, page 569 – 573, 577 – 582 3. Donal P Leach. Albert Paul Malvino and Gautam Saha, Digitalprinciples and applications, Seventh Edition, Mc Graw Hill, New Delhi (1986). Unit IV: Chapter 2, page 48 – 56, Chapter 3, page 74– 101, Chapter 6, Page 226 – 228. Unit V: Chapter 8, page 270 – 286, 288– 289, Chapter 10, page 341 – 346, 349 – 356,360 – 367.	
	BOOKS FOR REFERENCE: 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 of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	2	–	2	3	–	2	1	2
CO2	3	2	–	2	3	–	2	1	2
CO3	3	2	–	2	3	–	2	1	2
CO4	3	2	–	2	3	–	2	1	2
CO5	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	IV	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 Revisioneffected **(Minimum 20%)**	20%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The development of Physics concepts are introduced in the order of the development of concepts. Also the advanced level optics utilization principles areintroduced in the form of lasers.		

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 – DeBroglie 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 – Anamalous 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 Optical Amplification – The Line –Shape Function – Typical Parameters for a Ruby laser – Monochromaticity of the Laser Beam	13
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 natureand 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. **CO 4:** 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 PublishingCompany 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 – PageNumber: 267– 304 . 3. Atomic Physics (Modern Physics) – S.N.Ghoshal, S.Chand & CompanyLtd., (2004) Unit III: Page Number: 100– 141 . 4. Optics, Ajoy Ghatak– (2005) by Tata Mc Graw– Hill, 2nd Edition2005. Unit IV:Chapter 23, Pages 23.3– 23.36. Unit V: Chapter 24, Pages 24.3– 25.3.	

Mapping of COs with PSOs:

PSO / CO	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	IV	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 Revisioneffected **(Minimum 20%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **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** 1. Provide the physical understanding of mathematical insight about all physical items. 2. Value the liquid dynamics and charge properties of matter through the mathematical formulation. 3. 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 – eigen values 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 ofvariables.	10
IV	Special functions – Bessel functions – generating functions – recurrence relations – Legendre differential equation – Power series solution – Legendre polynomials – generating functions – recurrence relations.	10
V	Beta – Gamma functions – Fourier series and Fourier transforms and applications.	9

References	**Text Books** 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 778 – 782, 861 – 874, 1086 – 1101
	Reference Books 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	**On completion of the course, students should be able to do** **CO 1:** To make the students to explore the conceptualization of the scalar and vectorial functions using different vector operators, through the vector dot and vector cross product. **CO 2:** To give the students the highly perspective transformation theorems to make them understand the configurational geometry ofsystems. **CO3:** To know the matrix methods of diagonalization, finding inverse, and to find the eigenvectors by utilizing Cayley– Hamilton theorem. **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. **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 gammaand beta functions.

Mapping of COs with PSOs:

PSO / CO	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	IV	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 Revisioneffected **(Minimum 20%)**	
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **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** 1. To understand the heat conduction phenomena through some standard experiments. 2. To evaluate the current sensitivity and voltage sensitivity of voltmeters and ammeters through some experiments . 3. To understand the AC circuit phenomena of active and passive discrete component		

UNIT	Content	No. of Hours
I	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 ofvaporization 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. 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 Table galvanometer 12. Suspended coil Galvanometer – i) Measurement of low voltage – emf of Thermocouple. ii)Measurement of current – conversion into milli–voltmeter iii)Measurement of resistance 13. Ballistic galvanometer i)Figure merit and measurement of charge ii)Capacitance of a capacitor iii)Self inductance of a coil iv)Mutual inductance between a pair of coils v)High resistance by leakage vi)Measurement of current and resistance 14. Measurement of time constants of circuits – LR, CR	

Semester	IV	Course Code	**21PHYU04D1/ 21PHYU04G1**
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 Revisioneffected **(Minimum 20%)**	20%
Category	**Discipline Centric Elective/ Generic Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• 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** 1. It gives basic functionalities of different types of energy systems in everyday life. 2. 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 – Physics 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 – heat – Solar distillation – solar pumping – solar furnace – solar cooking.	10

III	Wind energy – Basic principles of wind energy conversion – 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 – advantages and disadvantages of WECs.	9
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.	10
V	Geothermal and OTEC – Introduction – nature of geothermal fields – geothermal sources – hydrothermal (convective resources) – basic ideas of vapor 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.	10
References	**Text Books** 1. 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 HillBook 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 onearth's surfaces. **CO 2:** Describe the different types of wind energy conversiontechnologies. **CO 3:** Explain the biomass conversion technologies and its classifications. **CO 4:** Illustrate the methods of generating energy form Geothermalsources. **CO 5:** Differentiate an open cycle with a closed cycle OTCE power generation systems.	

Mapping of COs with PSOs:

PSO / CO	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	IV	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 Revisioneffected **(Minimum 20%)**	20%
Category	**Discipline Centric Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **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** 1. To get a insight about a milky way galaxy. 2. 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 (Trignometric) 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 – Some Important Radio Galaxies – Seyfert Galaxies Quasars – The Discovery – Radio Properties – Optical Properties – The Red Shift of Quasars – Active Galactic Nuclei.	10
IV	**Milky way Galaxy:** Rotation of the Galaxy – Differential Rotatio – 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 Astro Physics – 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. andDonner,K.J. eds., 2016. Springer. 3. Astrophysics: stars and galaxies – Abhyankar, Krishna Damodar. UniversitiesPress, 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. Extragalacic 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	**On completion of the course, students should be able to do** **CO 1:** To help gaining knowledge on the stellar atmosphere through various sections and constituents. **CO 2:** To study the Surface temperatures of the stars through various physical models and hence to classify various stars. **CO 3:** To make the students understand, the internal structures of the stars through various equilibrium conditions suggested by various theoretical models. **CO 4:** To study the Milky Way galaxy presence and their properties through various theoretical information. **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 thepresent and in the future**.**

Mapping of COs with PSOs:

PSO / CO	**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	IV	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	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **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** 1. To impart knowledge about waves and oscillations and sound. 2. 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 wave front at plane surface – Experimental demonstration of refraction of sound – Diffraction of sound – Fresnets Assumptions – Intensity of sound at a point due toplane wavefront – Dopper 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 and Subramanyam –Waves and Oscillations‖, S.Chand and 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 of COs with PSOs:

PSO / CO	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	IV	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%)	20%
Category	**Generic Elective – I**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed bythe Course	• **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** 1. To Identify the distribution of mass in human body 2. 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 – bunting. Analysis Of Tennis Techniques – Grip – striking – serve – direction of flight of ball – guiding principles (video demonstrations of the above events).	10
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 – Dribblingand 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	**Text Books** 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 ofchapters 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	**On completion of the course, students should be able to do** 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.	

Mapping of COs with PSOs:

PSO / CO	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	IV	Course Code	**21PHYU04G3**
Course Title	**Physics of Sound and Acoustics**		
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 – I**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed bythe Course	• **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** 1. To understand about basic ideas of sound. 2. 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.	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.	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. Wind Instruments modes of oscillation in open and closed pipes – Different types of wind instruments – examples from Carnatic and western – Vibrations in Stretched Membranes and Plates. Drums – cymbals etc.	10
IV	**ELECTRONIC INSTRUMENTS OF SOUND:** Microphones (carbon and crystal) – pickup – Loud speaker – Amplifiers –Addition of sound – santoors.	9

V	**ACOUSTICS OF BUILDINGS:** Tape recording and play back equalizers – Recording and reproduction of sound in cine films. Acoustic of Buildings – Acoustics – Reverberation and Reverberation time – Acoustic measurements – Acoustic intensity level – Acoustic pressure level – Factors affecting the acoustics of buildings – sound distribution inan Auditorium – Requisites for good acoustics.	10
References	**Text Books** 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	**On completion of the course, students should be able to do** **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.	

Mapping of COs with PSOs:

PSO / CO	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	V	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	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the Course	• **K– 2: (Understand)** • **K– 3: (Apply)** • **K– 4: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims** 1. To make the students understand the basic concepts involved in electrostatics and electromagnetics 2. To enable the students to solve problems involving electric field intensity, electric potential under various situations 3. To give a knowledge on the fundamentals of electromagnetics so that they can be employed in future higher studies. 4. To educate the students to apply the knowledge of electromagnetic induction in real time problems		

UNIT	Content	No. of Hours
I	**Electrostatic fields in vacuum**: Coulombs law – 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 – Electric dipole – potential energy of a charge distribution – energy density in an electric field.	14
II	**Electrostatic fields in dielectric medium**: Electric polarization – electric field at an exterior point – electric field at an interior point– electric field intensities due to distant and near dipoles – relative permittivity and Poisson's equation for dielectrics – 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 at its center.	13

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 – Force on a point chargemoving 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.	13
IV	**Magnetic Induction and magnetic energy**: Faraday's law of induction – Induced electric field intensity in terms of vector potential – electromotance induced in a loop by a pair of long parallel wires – 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 – mutual inductance – self– inductance of a long solenoid – mutual inductance between two coaxial solenoids – coefficient of coupling.	12
V	**Magnetic materials:** Magnetization – 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. **Maxwell's equations**: Differential form – Integral form – Duality – Lorentz's Lemma – Non– homogeneous equations for E and B.	12
References	**Text Books (with chapter number & page number, wherever needed):** Electromagnetic fields and Waves – Paul Lorrain and Dale Corson, II Edn. CBSPublishers 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.	
	Reference Books: 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).	

	Related Online Courses – MOOC https://www.edx.org/course/dian– ci– xue– electromagnetism– tsinghuax– uphys3x https://www.edx.org/course/electricity– and– magnetism– magnetic– fields– and– forces https://www.edx.org/course/electricity– and– magnetism– electrostatics https://www.edx.org/course/preparing– ap– physics– c– electricity– georgetownx– phyx152x– 1 https://www.edx.org/course/apr– physics– 2– part– 2– electricity– ricex– advphy2– 2x– 0
Course Outcomes	**On completion of the course, students should be able to do** CO1: Will be aware of electric dipoles, usage of Gauss's law, nature ofelectric field and potential due to simple charge distributions CO2: Will be able to calculate electric field intensity and potential insideand outside point charge and arbitrary charge distributions CO3: Will have knowledge on dielectrics, local field, electric polarizationand displacement currents CO4: Can analyse magnetic fields in closed conducting wires like solenoid, torroids, etc., CO5: Can solve problems in moving systems with the knowledge of magnetic induction and will be aware of Maxwell's equations

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

Mean = 168/67 = 2.51

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	V	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 Revisioneffected **(Minimum 20%)**	
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **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** 1. To understand the fundamental properties of atoms. 2. It gives a tool to understand different types of detectors. 3. It provides the uses of radioactive elements in medicine, agricultural andindustrial areas.		

UNIT	Content	No. of Hours
I	**THE CONSTITUENTS OF NUCLEUS AND SOME OF THEIR PROPERTIES:** 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)	12
II	**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 – illustrativeexamples.	12

III	**PARTICLE ACCELERATORS, NUCLEAR REACTIONS, NUCLEAR MODELS AND REACTORS : PARTICLE ACCELERATORS**: Low energy cyclic accelerators – cyclotron (fixed frequency) – variable energy cyclotron – betatron – linear accelerator (electron linear accelerators only)– synchrotron (synchro cyclotron only) **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 and fusion – atom bomb and hydrogen bomb. **NUCLEAR MODELS AND REACTORS:** Nuclear models – liquid drop model and shell model only – nuclear reactors – general design of a nuclear reactors (basic reactors) – swimming fool reactor – fast breeder reactor – chain reactions – fissile materials.	12
IV	**DETECTION AND MEASUREMENTS OF NUCLEAR RADIATIONS:** Introduction – ionization chamber – Geiger Muller counter – scintillation counter – cloud chamber – bubble chamber – nuclear emulsions.	12
V	**COSMIC RAYS:** Introduction – secondary cosmic rays – geomagnetic effects – effects of sea level and low altitudes – effects at high altitudes – interpretation of geomagnetic effects – absorption of cosmic rays – energy of mass measurements of secondary cosmic rays – showers – Cosmic ray primaries – Origin of cosmic rays **ELEMENTARY PARTICLES:** Introduction – classification of elementary particles – fundamental interactions – Gravitational interaction – electromagnetic interaction – weak interaction – strong interaction – conservation laws – conservation of linear momentum – conservation of angular momentum – conservation of energy – conservation of charge – conservation of lepton number – conservation of baryon number – conservation of isospins – conservation of strangeness – conservation of hypercharge – conservation of charge conjugation – conservation of parity – properties of elementary particles (basic properties only) – electron positron and positronium – proton and antiproton – neutron and antineutron – neutrino and antineutrino – mesons – K – mesons– quarks.	16

References	**Text Books** 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 and 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: 129– 133,143– 148,148– 152,156– 159,159– 162,165– 168 Unit V: 674– 683,686– 688,690– 691, 692– 705,707– 712,713– 714,725,745
Course Outcomes	**On completion of the course, students should be able to do** **CO1:** To give better insight to the students to provoke the fundamental radioactive decay, the concept of alpha, beta and gammaand learn about radioactive disintegration in terms of mean life, half life. **CO 2:** To know the types of Nucleons manifesting in isotopes, isobars and isotones. Furtherance, to understand the classifications of the light nuclei andheavy nuclei through empirical observations of binding energy per nucleon. **CO 3:** To cover the description and utilization of different types of accelerators and viabilities and their limitations. **CO 4:** To give inquisitive importance of the detectors such as ionization chambers, GM counters and photo multiplier tubes and their characterization. **CO 5:** To give complete a account of presenting the cosmic rays and their phenomenological effects on Earth's magnetic field, the latitudeand altitude effect.

Mapping of Cos with PSOs:

PSO / CO	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	V	Course Code	**21PHYU0513**
Course Title	**Classical Mechanics and 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%)**	
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **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** 1. Understand the Newton's law, virtual work and D'Alember's principleunderstand the dynamical system moving with the relativistic speed.		

UNIT	Content	No. of Hours
I	**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 Lagrangian for a charged particle moving in an electromagnetic field (Gyroscopic forces) – Hamiltonian's principle and Lagrange's equations.	12

II	**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 systems (Holonomic constraints).	12
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 plantery 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 – uniformlyrotating frames – free fall of a body on Earth's surface – Foucault's pendulum.	14
V	**SPECIAL THEORY OF RELATIVITY– LORENTZ TRANSFORMATION:** Introduction – Galilean transformation – principle of relativity – transformation of force from one inertial system to another – covariance of the physical laws – principle of relativity and speed of light – the Michelson – Morley experiments – Ether hypothesis – postulates of special theory of relativity – Lorentz transformation – consequence of Lorentz transformations– length contraction – simultaneity – time dilation – addition of velocities.	14
References	**BOOKS FOR STUDY** Classical Mechanics by J.C.UPADHAYA Himalaya Publishing Housesecond revised edition. Unit– I : Page no 27– 53. Unit– II : Page no 138– 149. Unit– III: Page no103– 125. Unit– IV: Page no 320– 329. Unit– V : Page no 334– 353. **BOOKS FOR REFERENCE** 1. Classical Mechanics– H. Goldstein – II Edition, Narosa Publishing House, New Delhi – 1995. 2. Mechanics – Schaum's series : Third Edition Chapter VII P.	

References	**BOOKS FOR STUDY** 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 no103– 125. Unit– IV: Page no 320– 329. Unit– V : Page no 334– 353. **BOOKS FOR REFERENCE** 1. Classical Mechanics– H. Goldstein – II Edition, Narosa Publishing House, New Delhi – 1995. 2. Mechanics – Schaum's series : Third Edition Chapter VII P.
Course Outcomes	**On completion of the course, students should be able to do** CO 1: Understand the Newton's law, virtual work and D'Alember's principle CO 2: Apply the Hamiltonian's and Lagrangian principle to solve the equationof 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:

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	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	V	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 Revisioneffected **(Minimum 20%)**	5%
Category	**Practical**		
Scope of the Course	1. Hands on training on sophisticated and ordinary instruments operation and their uses have been exposed		
Cognitive Levels addressed bythe Course	• **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** 1. To giver Hands on training on sophisticated and ordinary instruments operation. 2. To understand about the Maintenance, reassembling and servicing.		

UNIT	Content	No. of Hours
I	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 and 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 Servicing of Balances Telescopes Microscopes Rheostats Galvanometers, Ammeters & Voltmeters 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 andload 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.	

Semester	V	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 Revisioneffected **(Minimum 20%)**	5%
Category	**Discipline Centric Elective**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The principle of operation of ac voltmeters and milli voltmeters with preamplifiers will be introduced.		

UNIT	Content	No. of Hours
I	Instruments accuracy – precision – sensitivity – resolution range etc. Errors in measurements and loading effects. Multimeter – Principles of measurement of dc voltage and dc current – ac voltage – ac current and resistance. Specifications of a multimeter and their significance. Electronic Voltmeter – Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage – measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter – Type of AC millivoltmeters – Amplifier – rectifier – and rectifier – amplifier. Block diagram AC millivoltmeter – specifications and their significance.	10
II	Block diagram of basic CRO – Construction of CRT– Electron gun – electrostatic focusing and acceleration (Explanation only – no mathematical treatment) – brief discussion on screen phosphor – visual persistence and chemical composition – Time base operation – synchronization – Front panel controls – Specifications of a CJRO and their significance – 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 – Blockdiagram and principle of working.	10

III	Block diagram – explanation and specifications of low frequency signal generators – pulse generator – and function generator – Brief idea for testing – specifications – Distortionfactor meter– wave analysis.	8
IV	Block diagram of bridge – working principles of basic (balancing type) RLC bridge – Specifications of RLC bridge – Block diagram and working principles of a Q – Meter– Digital LCR bridges.	10
V	Principle and working of digital meters – Comparison of analog and 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 – time– base stability – accuracy and resolution.	10
References	**REFERENCE BOOKS:** 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. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc– Graw Hill Electronic circuits– Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India	
Course Outcomes	**On completion of the course, students should be able to do** CO1: Will have a sound knowledge of terms like precision and accuracy. CO2: Will be capable of testing and standardizing meters like voltmeter, ammeter and ohmmeter. CO3: Can make measurement of voltages, phase changes and frequencyusing CROs. CO4: Will be capable of testing the goodness of signal generators CO5: Can work with resonant circuits and design them.	

Mapping of COs with PSOs:

PSO / CO	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	V	Course Code	**21PHYU05D5**
Course Title	**Television Transmission and Receiver**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revisioneffected **(Minimum 20%)**	10%
Category	**Discipline Centric Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed by the Course	• **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** 1. Academic and practical knowledge on TV functioning and its servicing skill areincorporated. 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 verticalpulse train .	8
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 orthicon – Videocon – plumb icon – CCD. 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.	10
IV	**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.	10
V	**Television applications**: Cable television MATV & CATV – closed circuit (CCTV) theatre television – Video tape recording play back – Television via satellite. **Fault finding:** Trouble shooting in monochrome receivers.	10
References	**Text Books** 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).	
Course Outcomes	**On completion of the course, students should be able to do** **CO 1:** have a complete knowledge about transmission and reception of television signals. **CO 2:** be able to differentiate between various sync signals **CO 3:** identify defects in a TV and can suggest remedies **CO 4:** be capable of understanding and operating video cameras **CO 5:** be able to install and operate DTH and cable television.	

Mapping of COs with PSOs:

PSO / CO	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	V	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 Revisioneffected **(Minimum 20%)**	
Category	**Discipline Centric Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 2: (Understand)** • **K– 3: (Apply)** • **K– 4: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. Acquire the knowledge on fundamentals of Microprocessors Acquire knowledge about memory mapping **Write a program for a specific application** 1. Gain knowledge for debugging of programs 2. Find the features of microcontrollers, design and construct circuits for social needs.		

UNIT	Content	No. of Hours
I	**MICROPROCESSOR ARCHITECTURE & MICRO COMPUTER 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 – Flip– Flop as a storage element – Memory map and Address – Memory Address of a 1K Memory chip –8085 Programming model – Instructions classification – Instructions and data format – Executing a simple program – Over view of the 8085 instruction set.	12
II	**INTRODUCTION TO 8085 INSTRUCTIONS:** Data transfer operations – Arithmetic operations – Logic operations – Branchoperations – 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 memory – Logic operations – Rotate – Compare – Dynamic debugging.	10
IV	**COUNTERS AND TIME DELAYS:** Counters and Time delays – Hexadecimal counter – Zero to Nine counter – Generating pulse waveforms – Debugging counter and time delay programs. **STACK AND SUBROUTINES:** Stack – Subroutine – Traffic signal controller – Restart – conditional call and return instructions – Advanced subroutine concepts.	8
V	**GENERAL PURPOSE PROGRAMMABLE PERIPHERAL DEVICES:** The 8255A Programmable Peripheral Interface – Interfacing Keyboard and Seven Segment Display.	8
References	**BOOKS FOR STUDY:** 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– 60 Unit V : Chapter 15 Pages: 445–471	
	BOOKS FOR REFERENCE: Introduction to microprocessors– II – A.P. Mathur (1988) Edn., TMH, New Delhi.8080A / 8085 assembly language programming – L.A. Leventhal 8080A / 8085 assembly language subroutines – L.A.Leventhal and W. Saville.	
	E– Resources (URLs of e– books / YouTube videos / online learning resources, etc.)https://www.edx.org/course/embedded– systems– shape– the– world– microcontroller– input output https://www.edx.org/course/embedded– systems– shape– the– world– multi– threaded– interfacing	
Course Outcomes	**On completion of the course, students should be able to do** 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	

Mapping of COs with PSOs:

PSO / CO	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	V	Course Code	**21PHYU05G4**
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 Revisioneffected **(Minimum 20%)**	
Category	**Generic Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. This course will also provide a back ground on working with Meter Bridgeand potentiometer circuits. The course will make the student understand thebasics about conversion of a galvanometer to an ammeter and calibrating them.		

UNIT	Content	No. of Hours
I	**GENERAL IDEAS:** DC power supply – fault finding and servicing – characterization of a power supply – use of measuring instruments – 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).	10
II	**INSTRUMENTS IN THE PHYSICS LABORATORY :** Theory and measurements with (i) meter bridge (ii) potentiometer (Comparison of emfs – resistances – measurement of potentials) fault finding in metre bridge and potentiometer circuits – power measurement using tree voltmeters – transformers principle – reflected impedance and winding and transformers	10
III	**INSTRUMENTS IN THE PHYSICS LABORATORY II:** Moving coil / iron galvano meters – theory and characterization – conversion of a galvanometer into an ammeter/voltmeter 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:** Principles of radio transmission – simple receiver super heterodyne receiver and its servicing – basics of television receiver with a blockdiagram – simple fault finding in TV receivers and precautions to be adopted – high voltage measurement – magnetic tape recording principle and block diagram for the same – fault finding and servicing	10
V	**ELECTRICAL DEVICES AND OTHERS:** Earthling – 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.	8
References	**BOOK FOR STUDY:** 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** CO 1: Will be able to use a multimeter for measuring various electrical parameters CO 2: Will be trained in testing the goodness of specifications of audio oscillators and other instruments CO 3: Will be capable of converting a galvanometer for appropriate measurements CO 4: Will be able to make minor repairs on radio receivers and TVs CO 5: Can 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	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	V	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 Revisioneffected **(Minimum 20%)**	10%
Category	**Generic Elective – II**		
Scope of the Course (may be more than one)	• **Basic Skill / Advanced Skill** • **Skill Development** • **Employability** • **Entrepreneurship**		
Cognitive Levels addressed by the Course	• 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** 1. 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	**Text Books (with chapter number & page number, wherever needed):** 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 PublishingCompany 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	**On completion of the course, students should be able to do** CO1: Will understand the basic concepts of Physics related to agriculture. CO2: Will be able to analyze the various properties of soil. CO3: Will understand the technologies for characterization of nano particles. CO4: Will recognize the effects of water in soil. CO5: Will be able to analyze the physical constraints in agriculture.	

Mapping of Cos with PSOs:

PSO / CO	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

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	V	Course Code	21PHYU05G6
Course Title	PHYSICS OF CRYSTALS		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	**Generic Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. Give the Symmetry, properties and the crystal structures. 2. 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, Latices, 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 – Spacegroups 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 nad its properties – History of precious crystals – Diamond mining in India – Physical properties ofdiamonds and sapphire – crystal structure and growth – Mechanical – optical and thermal properties of diamonds and sapphire – artificial diamonds – diamond polishing.	10

References	**BOOKS FOR STUDY AND REFERENCE:** 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	**On completion of the course, students should be able to do** 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

Mapping of COs with PSOs:

PSO / CO	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

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	V	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%)**	
Category	**Skill Based Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: Understand)** • **K– 2: (Apply)** • **K– 3: Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. This course will also provide a back ground on working with Meter Bridgeand potentiometer circuits. 2. The course will make the student understand thebasics about conversion of a galvanometer to an ammeter and calibrating them.		

UNIT	Content	No. of Hours
I	**GENERAL IDEAS:** DC power supply – fault finding and servicing – characterization of a power supply – use of measuring instruments – 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).	10
II	**INSTRUMENTS IN THE PHYSICS LABORATORY :** Theory and measurements with (i) meter bridge (ii) potentiometer (Comparison of emfs, resistances– measurement of potentials) fault finding in metre bridge and potentiometer circuits – power measurement using tree voltmeters – transformers principle – reflected impedance and winding and transformers	10
III	**INSTRUMENTS IN THE PHYSICS LABORATORY II:** Moving coil / iron galvanometers – theory and characterization – conversion of a galvanometer into an ammeter/voltmeter 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:** Principles of radio transmission – simple receiver super heterodyne receiver and its servicing – basics of television receiver with a blockdiagram – simple fault finding in TV receivers and precautions to be adopted– high voltage measurement – magnetic tape recording principle and block diagram for the same – fault finding and servicing	10
V	**ELECTRICAL DEVICES AND OTHERS:** Earthling – 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.	8
References	**BOOK FOR STUDY:** 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** CO 1: Will be able to use a multimeter for measuring various electrical parameters CO 2: Will be trained in testing the goodness of specifications of audio oscillators and other instruments CO 3: Will be capable of converting a galvanometer for appropriate measurements CO 4: Will be able to make minor repairs on radio receivers and TVs CO 5: Can 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	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	V	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)	• 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	• 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** 1. To impart knowledge about Fourier optics, Holography and Fiber Optics.		

UNIT	Content	No. of Hours
I	**Sources and Detectors:** Lasers – Spontaneous and stimulated emissions – Theory of laser action – Einstein's coefficients – Light amplification – Characterization of laser beam – He – Ne laser – Semiconductor lasers.	9
II	**Fourier Optics:** Concept of Spatial frequency filtering – Fourier transforming property of a thin lens.	7
III	**Holography:** Basic principle and theory– coherence – resolution – Types of holograms – white light reflection hologram – application of holography in microscopy – interferometry – and character recognition.	7
IV	**Photonics: Fibre Optics** Optical fibres and their properties – Principal of light propagation through a fibre – The numerical aperture – Attenuation in optical fibre and attenuation limit – Single mode and multimode fibres – Fibre optic sensors– Fibre Bragg Grating.	9

References	**Text Books (with chapter number & page number, wherever needed):** 1. Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill. 2. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak,2010, Tata McGraw Hill 3. Fiber optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books Nonlinear Optics, Robert W. Boyd, (Chapter– I), 2008, Elsevier.. 4. Optics, Karl Dieter Moller, Learning by computing with modelexamples, 2007, Springer. 5. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHILearning Pvt. Ltd. 6. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996,Cambridge Univ. Press
Course Outcomes	**On completion of the course, students should be able to do** CO1: Explain Theory of laser action and Einstein's coefficients CO2: Describe the Characterization of laser beam, He– Ne laser and Semiconductor lasers CO3: State the Concept of Spatial frequency filtering. CO4: Illustrate the Fourier transforming property of a thin lens CO5: Describe the principle and theory of holography and types of holograms.

Mapping of Cos with PSOs:

PSO / CO	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	V	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%)**	5%
Category	**Skill Based Elective**		
Scope of the Course (may be more than one)	• **Basic Skill / Advanced Skill** • **Skill Development** • **Employability**		
Cognitive Levels addressedby the Course	• 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** 1. 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		

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 – airtemperature – 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, 3rd 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 of Cos with PSOs:

PSO / CO	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

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	VI	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%)**	20%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels Addressed by the Course	• K– 1: (Understand) • K– 2: (Apply) • K– 3: (Analyze)		
Course Objectives (Maximum: 5)	**The Course aims to** 1. Acquire the knowledge of fundamental principles, phenomena and concepts in solid state physics. 2. Understand and describe the different experimental X– ray diffraction methods and lattice vibration, free– electron, band theories of solids. 3. Explain the theories underlying dielectric, optical, magnetic and superconductive properties. 4. Classify the properties of semiconductors, dielectrics, optical, magnetic and superconductive materials. 5. Apply the theories to explain the properties of solids.		

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 – 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 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.	9

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.	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	**BOOKS FOR STUDY AND REFERENCE:** 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.	
	BOOK FOR REFERENCES: 1. Introduction to Solid State Physics by C. Kittel , Wiley Eastern (1984) 2. Elements ofSolid State Physics by Ali Omar, Addison Wesley (1998)	
Course Outcomes	**On completion of the course, students should be able to do** **CO 1:** Will be aware of basics of crystallography and its symmetry operations. **CO 2:** Will be able to understand the concept of reciprocal lattice and importance of X– ray diffraction. **CO 3:** Will become capable of using various theories on specific heat and its behavior to specific applications. **CO 4:** Will become capable of understanding the phenomena of superconductivity and its impact due to magnetic, thermal and mechanical effects. **CO 5:** Capable of utilizing the properties of semiconductors and its behavior for device applications.	

Mapping of COs with PSOs:

PSO / CO	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	VI	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 Revisioneffected **(Minimum 20%)**	5%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	1. 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 – Somerfield quantization 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 – interpretationof wave function – Eherenfest theorem – time independent Schrodinger equation – Stationary states – admissibility condition on the wave function.	10
III	**General Formalism of Quantum Mechanics:** Linear operator – Eigen function and eigen values – Hermitian operator – postulates of quantum mechanics – simultaneous measurability of observables – general uncertainty relation – relevant problems.	10
IV	**One Dimensional Energy Eigen value Problems:** Square – well potential with rigid walls – square well potential with finite walls – square potential barrier – alpha emission – linear harmonic oscillator – Schrodinger method.	8

V	**Three Dimensional Energy Eigen value Problems:** particle moving in a spherically symmetric potential – system of two interacting particles – hydrogen atom – Hydrogenic orbitals – three dimensional square well potential.	10
References	**BOOKS FOR STUDY AND REFERENCE:** Quantum Mechanics by G.Aruldhas (PHI) – 2006 Unit I : Pages: 1 to 21 of chapter 1. Unit II : Pages 22 to 48 of chapter 2. Unit III : Pages 53 to 62 of chapter 3. Unit IV : Pages 81 to 90 and pages 95 to 100. Unit V : Pages 114 to 130 and 132 of chapter 5.	
	BOOK FOR REFERENCES: 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	**On completion of the course, students should be able to do** CO1: Understand the limitations of classical physics and the need of quantum theory **CO2: U**nderstand the importance of wave– particle duality and de braglie concept **CO3:** Understand the general formalism of quantum mechanics, uncertainty principle and Schrödinger wave equation **CO4:** Apply the quantum mechanical formalism and Schrödinger equation to solve problems one dimensional, three dimensional eigen value problems: square well potential, harmonic oscillator and hydrogenatom **CO 5:** Understand the applications of quantum mechanical tunnelling to alpha particle emission, tunnel diode, TEM etc. and to appreciate the same.	

Mapping of COs with PSOs:

PSO / CO	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	VI	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%)**	10%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. 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 – 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.	12

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	**BOOKS FOR STUDY AND REFERENCE:** 1. Molecular structure and Spectroscopy, G.Aruldhas, Prentice Hall of India Private Limited, New Delhi – 110 001, Third Printing. Unit I : Page No: 56 – 91 2. Fundamentals of Molecular Spectroscopy, C.N. Banwell and M.Mc. Cash, IVth Edition, Tata McGraw Hill (1996). Unit– III: Pages: 55–66; 71–75; 91–93, chapter 3. Unit– IV: Pages: 100–106; 112, 113–116; 119–124 .	
Course Outcomes	**On completion of the course, students should be able to do** **CO 1: W**ill become capable of understanding the basics of spectroscopy and the interaction of atoms with electric, magneticfields. **CO2:** Will be able to analyze and apply visible spectrometry. **CO 3:** Will be capable of understanding various kinds of vibrations on different molecules and IR instrumentation. **CO 4:** Will be able to do structural exploration through IR and Raman spectra. **CO 5:** Will be aware of electronic – vibration transitions and Born–Oppenheimer approximation	

Mapping of COs with PSOs:

PSO / CO	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	VI	Course Code	**21PHYU0618**
Course Title	Practical – VI		
No. of Credits	2	No. of contact hours per Week	6
New Course / Revised Course	Revised	If revised, Percentage of Revisioneffected **(Minimum 20%)**	10%
Category	**Practical**		
Scope of the Course	**Core Course**		
Cognitive Levels addressed by the Course	• 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** 1. Explore to elemental presence by spectroscopy techniques. 2. To understand the various performances of logic gates in electronic circuits.		

UNIT	Content	No. of Hours
I	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 13. Study of trouble shooting in some simple electronic circuits 14. Michelson interferometer 15. Study of Doppler Effect 16. Verification of Boolean relations DeMorgan's theorem – Combinational Logic 17. Half adder, full adder and half subtractor	

Semester	VI	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%)**	10%
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed bythe Course	• **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** 1. To understand the mechanics of macroscopic system as well as microscopic system 2. It gives understanding about classical statistics and Quantum statistics		

UNIT	Content	No. of Hours
I	**Statistical Mechanics:** Microstate and macrostate – thermodynamic probability – Bose – Einsterin – Fermi – Dirac – Maxwell – Boltzmann statistics – Bose – Einsterin – Fermi – Dirac and Maxwell – Boltzmann – Distribution function – The partition function.	16
II	**Application of Statistical Mechanics:** Distribution of molecular velocities – Experimental verification – Einstein'stheory of specific heat capacity of a solid – Debye theory of specific heat capacity of solids – Black body radiation – The electron gas.	16

References	**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
Course Outcomes	**On completion of the course, students should be able to do** CO1: Gives elementary idea on the subject CO2: Understand the classification of particles

Mapping of COs with PSOs:

PSO / CO	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	VI	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%)**	
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels Addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. To provide the students with knowledge of electrical network theoremand electrical component properties. 2. The student will be given inputs regarding various combinations of R, Land C so that these circuits will be understood.		

UNIT	Content	No. of Hours
I	**Network Theorem:** Thevenin's theorem – Norton's theorem – Superposition theorems – Maximum power transfer theorem –solving networks using theorems– current through the galvanometer in an unbalanced Wheatstone's bridge – sensitivity of Wheatstone's bridge – Carey Foster's bridge – Calibration of Carey Foster's bridge – Kelvin's double bridge. Ballistic Galvanometer – its theory and damping correction	14
II	**Transient Phenomena:** Growth and decay of current in an LR circuit – time constant charging and discharging of a capacitor through a resistor – 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 series and parallel circuits resonance – sharpness of resonance – Q factor of a coil– power in – AC circuits – AC bridges – Maxwell's bridge – Schering bridge – De Sauty'sbridge – Anderson's bridge.	18

References	**BOOKS FOR STUDY AND REFERENCE:** Electricity and magnetism – K.K. Tiwari, S. Chand and Co., Unit I – Electricity and Magnetism by K.K. Tiwari. Pages: 769–790 of chapter21 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:

PSO / CO	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

Mean = 30/ 18 = 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	VI	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%)**	
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels Addressed by the Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The course aims to introduce concepts on lasers, pulsed high power lasers and various gas, liquid and solid state lasers. 2. Advanced topics like second harmonic generation and self focusing of light will be introduced. 3. In addition the course will provide a knowledge of optical fibers, optical communication and different sources and detectors for the same.		

UNIT	Content	No. of Hours
I	**Properties of laser light, Q – Switching and mode locking:** single mode and multimode lasers – Lamb Dip – mode locking of multimode lasers – Q – Switching – Ammonia maser – Gas lasers – Solid State Lasers – Dye Lasers – Semiconductor lasers – Non linear optics – Second Harmonic generation – Phase matching – Self focusing of light.	16
II	**FIBRE OPTICS :** Introduction – Nature of light – basic optical laws – optical fibre 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 – Scattering losses – bending losses – Core and Cladding losses – Fibre Optic cables – Fibre optic communication system and its advantages – Specific applications on Fiber Optics.	16

References	**BOOKS FOR STUDY** 1. Lasers and Non linear Optics, B.B. Laud, Wiley Eastern Ltd., New Delhi,1992, Unit I Chapter 13: PP 178 – 218. 2. Optical fibre communication, Gerd Keiser, McGraw Hill, International edns,New York 1991, Unit II Chapter 2, Chapter2 PP 16– 59, 73 – 75, 85 – 96.
	BOOKS FOR REFERENCE 1. Optics, Ajoy Ghatak, Tata McGraw Hill, New Delhi, 1995. 2. Lasers, Theory and Applications, A.K. Ghatak & K. Thiagarajan, MacmillanIndia Ltd., Delhi 1984
Course Outcomes	**On completion of the course, students should be able to do** CO 1: Will have a sound knowledge of lasers CO 2: Can understand and operate optical communication systems.

Mapping of COs with PSOs:

PSO / CO	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	VI	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 Revisioneffected **(Minimum 20%)**	5%
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The aim of this course is for awareness and understanding regarding radiation hazards and safety. The list of laboratory skills and experiments listed below thecourse are to be done in continuation of the topics.		

UNIT	Content	No. of Hours
I	**Interaction of Radiation with matter:** **Types of Radiation:** Alpha, Beta, Gamma and Neutron and their sources – sealed and unsealed sources – Interaction of Photons – Photo – electric effect – Compton Scattering – Pair Production – Linear and Mass Attenuation Coefficients – Interaction of Charged Particles – Heavy charged particles – Beth – Bloch Formula – Scaling laws– Mass Stopping Power – Range – Straggling – Channeling and Cherenkov radiation.	11
	Beta Particles Collision and Radiation loss (Bremsstrahlung) – Interaction of Neutrons – Collision – slowing down and Moderation. **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 – Nuclear waste and disposal management – Brief idea about Accelerator driven Sub– critical system (ADS) for waste management.	11

II	**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 – Annual Limit of Intake (ALI) and derived Air Concentration (DAC) – **Radiation detection:** Basic concept and working principles of gas detectors (Ionization Chambers – Proportional Counter – Multi–Wire Proportional Counters (MWPC) and Gieger Muller Counter) – Scintillation Detector (Inorganic and Organic Scintillators) – Solid States Detectors and Neutron Detectors – Thermo luminescent Dosimetry.	10
References	**BOOKS FOR REFERENCE** 1. W.E.Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995) 2. G.F.Knoll, Radiation detection and measurements. 3. Thermoluninescense Dosimetry, Mcknlay, A.F., Bristol, AdamHilger (MedicalPhysics Handbook 5) 4. W.J.Meredith and J.B.Massey, ―Fundamental Physics of Radiology‖. JohnWright and Sons, UK, 1989. 5. J.R.Greening, ―Fundamentals of Radiation Dosimetry‖, Medical Physics HandBook 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** CO 1: Can recognize different kinds of radiations. **CO 2:** Will be capable of designing radiation protection mechanisms	

Mapping of COs with PSOs:

PSO / CO	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	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 Revisioneffected **(Minimum 20%)**	
Category	**Allied Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. Understand the basic concepts of acceleration due to gravity, determination and the factors affecting its values.		

UNIT	Content	No. of Hours
I	**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. **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.	12
II	**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 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.	10

III	**SOUND:** Velocity of longitudinal waves in gases – Newton's law of velocity of sound– Laplace's correction – Effect of density – humidity and wind – velocity of sound inwater and in air – measurement of sound intensity– idea of decibel – Ultrasonics – Production– Magnetostriction Method – Piezo – electric Effect – determination of velocity– Acoustic Grating– Applications of ultrasonics (any two)	10
IV	Interference – Condition for interference – Young's experiment – Fresnel biprism – Bi– mirror – Lloyd's singlemirror – Fringes with while light – Colours of thin films – Reflected and transmitted systems – Newton's rings – Airwedge – Testing of planes of a surface.	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	**BOOKS FOR STUDY** 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 Brijlal 6. A text book of Sound – Subrahmanyam and Brijlal 7. Properties of Matter– Subrahmanyam and Brijlal	
	BOOKS FOR REFERENCE 1. Physics – V Edition. Volume I David Halliday, Robert Resnick – Jearl Walker – Asian Books	
Course Outcomes	**On completion of the course, students should be able to do** CO 1: Understand the basic concepts of acceleration due to gravity, determinationand the factors affecting its values. CO 2: Learn the Kepler's laws of planetary motion and determine the mass &density of the Earth and Sun CO 3: Basics of ultrasonic production , measurement and application CO 4: Apply the principle of interference in forming Newton's ring and test thepaleness by air wedge method CO 5: Explain the principle of polarization and apply the principle to optical applications.	

Mapping of COs with PSOs:

PSO / CO	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	6
New Course / Revised Course	Revised	If revised, Percentage of Revisioneffected **(Minimum 20%)**	20%
Category	**Allied Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. Basic knowledge about measuring instruments		

UNIT	Content	No. of Hours
I	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–uniformbending. 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	II / IV	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 Revisioneffected **(Minimum 20%)**	
Category	**Allied Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed bythe Course	• **K– 1: (Understand)** • **K– 2: (Apply)** • **K– 3: (Analyze)**		
Course Objectives (Maximum: 5)	**The Course aims to** 1. The student should be able to gain enough knowledge to effectively learnthe subjects in which they will be majoring		

UNIT	Content	No. of Hours
I	**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.	12
II	**ANALOG AND DIGITAL ELECTRONICS:** Semiconductor electronics – Diode– Zener diode – Half and Full wave rectifiers – ideas of filters – Transistors – biasing of a transistor – input andoutput characteristics – single stage CE amplifier and its frequency response – Feed – back and its effects – oscillators – Colpitt's and Hartley oscillator. Logic gates – their symbol and truth table – Universal gates NAND and NOR – Boolean Identities – De Morgan's theorem – Half – Adder and Full – Adder – solving Boolean equations using laws and theorems.	10
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 earth – basic ideas of equilibrium in radioactivity – discovery of neutron – properties – nuclear fission and fusion reactions – liquid drop model (qualitative treatment only) – nuclear reactor – fissile materials – moderators – chain reactions – application of radioisotopes in medicine and agricultural – accelerators – linear accelerators– cyclotron – synchro cyclotron – detector– ionization chamber – G.M. Counter.	10
V	**Lasers:** Introduction – 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	**BOOKS FOR STUDY AND REFERENCE:** 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 – TTTIPublications, Chandigarh 6. Digital Principles – Malvino and Leach, McGraw Hill. 7. Nuclear physics by D.C.Dhayal (Himalaya Publishing House– Fifth revised & enlarged edition.	
Course Outcomes	**On completion of the course, students should be able to do** **CO1:** Understand and apply AC and DC circuits. **CO2:** Design simple power supplies **CO3:** Apply logic gates for implementation of logical circuits **CO4:** Understand the particle wave duality **CO5:** Apply radio isotopes for specific applications like agriculture and medicine	

Mapping of COs with PSOs:

PSO / CO	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	I	Course Code	21PHYUVAC1
Course Title	**RENEWABLE ENERGY PHYSICS**		
No. of Credits	2	No. of contact hours per Week	2
New Course/ RevisedCourse	New Course	If revised, Percentage of Revision effected **(Minimum20%)**	
Category	**Value Added Programme**		
Scope of the Course (may bemore than one)	• Basic Skill /Advanced Skill • Skill Development • Employability • **Entrepreneurship** • **Value– Added Courses imparting transfer able and life Skills** • **Field Placement/Field Project** • Internship		
Cognitive Levels Addressed by the Course	• 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** 1. Understand the importance of energy to the society. 2. Acquire knowledge on wind, solar energy and their utilization.		

UNIT	Content	No. of Hours
I	**WIND POWER AND HYDRO POWER** 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. 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.	16
II	**PHOTOVOLTAICS AND ENERGY CONVERSION AND EFFICIENCY** 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. Factors besides efficiency influencing energy related choices – Lowest of the low hanging fruit – Obstacles to efficiency and conversion – Problems.	16

References	Text Books (with chapter number & page number ,where very needed): (Robert Ehrlich, Renewable energy: A first course, CRC press, by Taylor & Francis Group, LLC, 2013. 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 For problems: Page no: 369	
Course Out comes	**On completion of the course, students should be able to** CO– 1 Understand the importance of energy to the society. CO– 2 Acquire knowledge on wind, solar energy and their utilization. CO– 3 Recall and infer the hydro power and the photovoltaic solar energy. CO– 4 Acquire knowledge on energy conversion and efficiency of solar cells . CO– 5 Analysis the solar photovoltaic system and the solar efficiency.	

Semester	II	Course Code	21PHYUVAC2
Course Title	**SOLAR PV PANEL INSTALLATION AND MAINTENANCE**		
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 (may bemore than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • **Entrepreneurship** • **Value– Added Courses imparting transfer able and life skills** • **Field Placement / Field Project** • Internship		
Cognitive Levels addressedby the Course	• 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** 1. Impart knowledge on the basics of PV panel 2. Train the students on installation of solar PV panel 3. Give awareness on the maintenance and safety.		

UNIT	Content	No. of Hours
I	**UNIT – I: SOLAR PANEL SYSTEM AND INSTALLATION:** Photovoltaic Solar Panels – Electrical Power System – Solar PVModules – 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	**ELECTRICAL INSTALLATION, TESTING AND TROUBLE SHOOTING:** 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 andTesting of Solar Power Plant – O and 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.	16
Reference	**Reference Books:** 1. Joseph Burdick and Philip Schmidt, –Install your own solar panels designing and installation‖, eBook version 1.0, 2017. 2. Mike Sullivan, –Solar Rooftop DIY‖, The Countryman Press, 2016.	
	E– Resources (URL sofe – books/YouTubevideos/online learning resources, etc.) https://www.greenmatch.co.uk/blog/2014/09/solar– panel– installation– and– maintenance https://solar– to– the– people.com/solar– installation– solar– maintenance/ https://merculexenergy.com/design– installation– and– maintenance– of– solar– pv– systems/	
Course Out comes	**On completion of the course, students should be able to** CO– 1 Acquire the knowledge about basics of electric and solar energy, and understand the solar PV system. CO– 2 Predict the need of solar power and solve this by installing PV system. CO– 3 Compare different installation techniques, implement the PV technique forsuitable places. CO– 4 Examine and the efficiency of PV system and compose a suitable systemfor the required power. CO– 5 Categorize the work ethics and work place safety, recommend the techniques to construct the PV system and design and construct the solar PVsystem to power a house.	

Semester	III	Course Code	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 (may bemore than one)	• Basic Skill/ Advanced Skill • Skill Development • Employability **Entrepreneurship** • **Value– Added Courses imparting transferable and life skills** • **Field Placement / Field Project** • Internship		
Cognitive Levels addressedby the Course	• 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** 1. 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 AFCIBreakers – House Surge Arrestors – Service Panels.	**12**
II	**HOUSE WIRING AND TROUBLE SHOOTING** Household Circuits – Single Phase wiring – Three Phase Wiring – 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 Downreset – 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	**20**

References	**Reference Books:** 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.
	E– Resources (URL sofe– books/YouTubevideos/online learning resources, etc.) https://www.hplindia.com/wire– cables/domestic– wires.php https://www.contractorbhai.com/basics– of– how– your– home– electrical– works/ https://www.primecabindia.com/all– about– house– electrical wiring– system– a– small– guide
Course Out comes	**On completion of the course, students should be able to** CO – 1 Acquire the knowledge and understand the basics of electricity, electrical components and wiring methods and troubleshooting. CO – 2 Classify various electrical components and its applications. CO – 3 Identify and assess the need, design and wire the panel CO – 4 Illustrate and explain the wiring circuits. Recommend and plan to wire a house and industry.

Semester	IV	Course Code	21PHYUVAC4
Course Title	**NON– DESTRUCTIVE TESTING**		
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 (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Employability **Entrepreneurship** • **Value– Added Courses imparting transferable and life skills** • **Field Placement / Field Project** • Internship		
	• K– 2:(Understand) • K– 3:(Apply) • K– 4:(Analyze) • K– 5:(Evaluate) • K– 6:(Create)		
Course Objectives (Maximum:5)	**The Course aims to** 1. Understanding to Use modern tools to examine flaw in the materials.		

UNIT	Content	No. of Hours
I	**VISUAL INSPECTION AND ACOUSTIC EMISSION TESTING:** 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 **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 and Theories – Principles and Theory – Equipment and Materials – Interpretation and Evaluation of Signals – Procedures.	**16**

II	**LEAK TESTING AND LIQUID PENETRANT TESTING:** 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. **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.	**16**
References	**Reference Books:** Dr. Baldev Raj, Jayakumar and M. Thavasimuthu, "Practical Non- Destructive testing", Narosa Publications, New Delhi, 2009.	
	E- Resources (URLs of e-books/You Tube videos / online learning resources, etc.) i) https://www.flyability.com/ndt ii) https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx iii) https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx	
Course Out comes	**On completion of the course, students should be able to** CO-1 Describe and discuss different NDT techniques as per requirements. CO-2 Use modern tools to examine flaw in the materials. CO-3 Solve various manufacturing defects by comparing the results of tests. CO-4 Apply accurate testing method for materials using NDT. CO-5 Examine and explain environment friendly solutions to achieve organizational sustainability with ethical values.	