BACHELOR OF SCIENCE IN PHYSICS

DEPARTMENT OF PHYSICS

Amaravati 522502, Andhra Pradesh

INDIA

CURRICULUM AND SYLLABI

(For students admitted from the academic year 2018)

Objectives:

1 To help the students to acquire a comprehensive knowledge and sound understanding of fundamentals of Physics.

2. To develop practical, analytical and mathematical skills of Physics.

3. To prepare students to acquire a range of general skills, to solve problems, to evaluate information, to use computers productively, to communicate with society effectively and learn independently.

4. To enable them to acquire a job efficiently in diverse fields such as Science and Engineering, Education, Banking, Public Services, Business etc.,

Eligibility: The candidates seeking admission to the B.Sc. Degree program shall be required to have passed (10+2) (Higher Secondary) examination or any other equivalent examination of any authority, recognized by this University, with Physics, Chemistry and Mathematics.

Duration: 3 Years (6 Semesters)

PROGRAME outcomes:

The curriculum and syllabus for the Bachelor degree in Physics (2018) conform to outcome based teaching learning process. In general, FOURTEEN STUDENT OUTCOMES (a-n) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped on to the student outcomes.

On successful completion of this Program, students will have the ability to

a) Apply knowledge of basic science, mathematics and computing appropriate to the discipline

b) Acquire knowledge and understanding of fundamental concepts, principles and theories related to the identified subject areas.

c) Acquire advanced knowledge in some areas of interest in physics and is familiar with contemporary research within various fields of physics.

d) Develop skills of critical thinking, hypothesis building, and to apply the scientific method to physics concepts, theoretical models and laboratory experiments.

e) Develop problem solving skill to, independently and creatively, identify and formulate problems and to plan and, use theoretical and/or experimental methods, carry out advanced tasks within specified time limits.

f) Develop the skill to combine and use knowledge from several disciplines to enter/propose novel ideas that require an analytic and innovative approach, and disseminate subject matter and results to both specialists and a broader audience.

g) Use computers effectively to solve problems through numerical methods and simulations and to analyze the data through available software.

h) Handle standard and advanced laboratory equipment, modern instrumentation and classical techniques to carry out experiments.

i) Develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory.

j) Collaborate and to lead collaborative work to accomplish a common goal.

k) Understands the role of physics in the society and have the background to consider ethical, legal and security issues and responsibilities.

l) Demonstrate written and oral communication skills for dissemination of scientific results in report, article, or oral presentation formats.

m) Develop an adequate background for pursuing pedagogic education and international perspective on her/his discipline, and a commitment to life-long learning and professional development.

n) Assist in the creation of an effective project plan.

SRM UNIVERSITY – AP, ANDHRA PRADESH

CURRICULUM FRAMEOWRK

PROGRAM:

REGULATION YEAR 2018:

CURRICULUM

SEMESTER I

Course Category	Course Code	Course Name	L	T	P	L+T +P	C
FC	FC-1	Foundation course 1	3	1	0	4	4
FC	FC-2	Foundation course 2	3	1	0	4	4
C	PHY102	Mathematical Physics	3	0	0	3	3
C	PHY 103	Mechanics – I	3	0	0	3	3
C	PHY 103L	Laboratory: Mechanics- I	0	0	4	4	2
E	SOFT SKILLS	Soft Skills					
		TOTAL	12	2	4	18	16

SEMESTER II

Course Category	Course Code	Course Name	L	T	P	L+T+P	C
FC	FC-3	Foundation course 3	3	1	0	4	4
FC	FC-4	Foundation course 4	3	1	0	4	4
C	PHY 111	Mechanics – II	3	0	0	3	3
C	PHY 111L	Laboratory: Mechanics – II	0	0	4	4	2
C	PHY 115	Electricity and Magnetism	3	0	0	3	3
C	PHY 115L	Laboratory: Electricity and Magnetism	0	0	4	4	2
C	Environmental Science	Environmental Science	4	0	0	4	4
		TOTAL	16	2	8	26	22

SEMESTER III

Course Category	Course Code	Course Name	L	T	P	L+T+P	C
FC	FC-5	Foundation course 5	3	1	0	4	4
C	PHY 201	Waves, Oscillations, and Optics	3	0	0	3	3
C	PHY 201L	Laboratory: Waves, Oscillations, and Optics	0	0	4	4	2
C	PHY 202	Heat and Thermodynamics	3	0	0	3	3
C	PHY 202L	Laboratory: Heat and Thermodynamics	0	0	4	4	2

A	Mathematics 1/ Biology-1/Economics-1	Mathematics 1/Biology-1/Economics-1	3	1	0	4	4
A	Chemistry 1 / Computer 1	Chemistry 1 / Computer 1	2	1	2	5	4
		TOTAL	14	3	10	27	22

SEMESTER IV

Course Category	Course Code	Course Name	L	T	P	L+T+P	C
FC	FC-6	Foundation course 6	3	1	0	4	4
C	PHY 212	Basic Electronics	3	0	0	3	3
C	PHY 212L	Laboratory: Basic Electronics	0	0	4	4	2
C	PHY 213	Quantum Mechanics	3	1	0	4	4
A	Mathematics 2/Biology-2/Economics-2	Mathematics 2/Biology-2/ Economics-2	3	1	0	4	4
A	Chemistry 2 / Computer 2	Chemistry 2 / Computer 2	2	1	2	5	4
		TOTAL	14	4	6	24	21

SEMESTER V

Course Category	Course Code	Course Name	L	T	P	L+T+P	C
C	**PHY 300R**	**Research Project-1**	**0**	**0**	**4**	**0**	**2**
C	**PHY 301**	**Atomic and Molecular Physics**	**3**	**0**	**0**	**3**	**3**
C	**PHY 302**	**Electrodynamics**	**3**	**0**	**0**	**3**	**3**
C	**PHY 303**	**Solid state Physics**	**3**	**0**	**0**	**3**	**3**
C	**PHY 304**	**Advanced Optics**	**3**	**0**	**0**	**3**	**3**
C	**PHY 301L**	**Laboratory: Atomic and Molecular Physics**	**0**	**0**	**4**	**4**	**2**
C	**PHY 302L**	**Laboratory: Electrodynamics**	**0**	**0**	**4**	**4**	**2**
C	**PHY 303L**	**Laboratory: Solid State Physics**	**0**	**0**	**4**	**4**	**2**
C	**PHY 304L**	**Laboratory: Advanced Optics**	**0**	**0**	**4**	**4**	**2**
		Total	**12**	**0**	**20**	**28**	**22**

SEMESTER VI

Course Category	Course Code	Course Name	L	T	P	L+T +P	C
C	**PHY 310R**	**Research Project-2**	**0**	**0**	**8**	**8**	**4**
C	**PHY 311**	**Statistical Physics**	**3**	**1**	**0**	**4**	**4**
C	**PHY 312**	**Nuclear and Particle Physics**	**3**	**0**	**0**	**3**	**3**
C	**PHY 312L**	**Laboratory: Nuclear and Particle Physics**	**0**	**0**	**4**	**4**	**2**
C	**PHY 313**	**Department Elective**	**3**	**0**	**0**	**3**	**3**
C	**PHY317**	**Department Seminar/Industry-Academic Visit**					**2**
		TOTAL	**9**	**1**	**12**	**22**	**18**

Total Credits: 16+22+22+21+22+18=121

List of foundation courses

Foundation course 1 (FC1)	
Foundation course 2 (FC2)	
Foundation course 3 (FC3)	
Foundation course 4 (FC4)	
Foundation course 5 (FC5)	
Foundation course 6 (FC6)	

List of Allied Subjects (Semester III and Semester IV)

Semester III	
Mathematics 1/Biology-1/ Economics-1	
Chemistry 1 / Computer 1	
Semester IV	
Mathematics 2/Biology-2/	

Economics-2	
Chemistry 2 / Computer 2	

List of Elective subjects

Soft Skills	
Departmental Elective (DE)	
Open Elective (OE)/ Course on Computer Concepts (CCC)	

SYLLABUS

SEMESTER –I

FOUNDATION COURSE 1 (FC 1)

FOUNDATION COURSE 2 (FC 2)

<table>
<tr><td rowspan="2">PHY 102</td><td colspan="2" rowspan="2">MATHEMATICAL PHYSICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Co-requisite:</td><td colspan="6">NIL</td></tr>
<tr><td>Prerequisite:</td><td colspan="6">NIL</td></tr>
<tr><td>Data Book / Codes/Standards</td><td colspan="6">NIL</td></tr>
<tr><td>Course Category</td><td></td><td>CORE</td><td colspan="4">MATHEMATICAL PHYSICS</td></tr>
<tr><td>Course designed by</td><td colspan="6">Department of Physics</td></tr>
<tr><td>Approval</td><td colspan="6">-- Academic Council Meeting -- , 2018</td></tr>
</table>

PURPOSE	The purpose of this course is to introduce the students to the fundamental mathematical requirements for the subsequent courses in the curriculum

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Use tools of vector calculus and complex variables to physical systems							
2.	To solve problems involving partial differentiation of multivariable functions							
3.	Solve first and second order linear differential equations for various physical systems using Power series, Laplace, Fourier transforms and other methods							
4.	To familiarize with the concept of linear vector spaces and their relations with matrix algebra							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT-I- Vector Algebra and Vector Analysis	**9**			
1.	Introduction to scalars, vectors, Dot product and cross product of vectors	1	C		1,2
2.	Scalar triple product and its geometrical interpretation, Vector triple product and its proof	1	C		1,2
3.	Differentiation of vectors with respect to scalar, Scalar and vector fields, Vector differential operator	1	C		1,2
4.	Gradient of scalar field and its physical significance	1	C-D		1,2
5.	Divergence of scalar field and its physical significance	1	C-D		1,2
6.	Curl of vector field and its physical significance	1	C-D		1,2
7.	Vector integrals: line, surface and volume integral with their examples	1	C		1,2
8.	Gauss-Divergence theorem	1	D-I		1,2
9.	Stoke’s theorem, Vector identities	1	D-I		1,2
	UNIT II – Complex Numbers	**9**			

10.	Introduction to complex numbers	1	C		1,2
11.	Algebra of complex numbers	1	C		1,2
12.	Argand diagram	1	C		1,2
13.	De-Moivre's Theorem	1	C		1,2
14.	Trigonometric, hyperbolic and exponential functions	1	C-D		1,2
15.	Powers, roots and log of complex numbers	1	C-D		1,2
16.	Applications of complex numbers: classical mechanics, LCR circuits	1	D-I		1,2
17.	determine velocity and acceleration in curved motion	1	D-I		1,2
18.	worked examples – determine velocity and acceleration in curved motion	1	D-I		1,2
	UNIT III – Partial differentiation	**9**			
19.	Definition of partial differentiation, Successive differentiation	1	C		1,2
20.	Total differentiation, exact differential	1	C		1,2
21.	exact differential, Chain rule	1	C		1,2
22.	Application - Change of variables from Cartesian to Polar co-ordinates	1	D-I		1,2
23.	Application - Change of variables from Cartesian to cylindrical co-ordinates	1	D-I		1,2
24.	Application - Change of variables from Cartesian to spherical co-ordinates	1	D-I		1,2
25.	Implicit and explicit functions	1	C		1,2
26.	Conditions for maxima and minima	1	C		1,2
27.	Worked examples for maxima and minima of two-variable functions	1	I		1,2
	UNIT IV: Differential equations	**9**			
28.	Ordinary differential equations (ODEs) and partial differential equations (PDEs)	1	C		1,2
29.	Series solution of ODEs	1	C		1,2
30.	Special functions- Legendre and Bessel functions	1	C		1,2
31.	Introduction to Laplace transformation	1	C		1,2

32.	Solutions for ODEs using Laplace transformation	1	C-D		1,2
33.	Introduction to Fourier analysis	1	C		1,2
34.	Solving PDEs using Fourier transformations	1	D		1,2
35.	Application of Differential equations in Physics – Radioactivity, conductivity and diffusivity	1	D-I		1,2
36.	Fourier equation for the propagation of heat, Steady state solution for rectilinear, radial and cylindrical flow of heat	1	D		1,2
	UNIT V: Matrix algebra	**9**			
37.	Linear equations and matrix formalism	1	C		1,2
38.	inverse of a square matrix	1	C		1,2
39.	Eigenvalues and eigenvectors of matrices	1	C		1,2
40.	orthogonal sets of eigenvectors	1	C		1,2
41.	orthogonal transformations	1	C-D		1,2
42.	Hermitian and unitary matrices	1	C-D		1,2
43.	diagonalization of matrices	1	D		1,2
44.	Linear vector spaces, the dual space and the scalar product	1	C-D		1,2
45.	linear operators, Hermitian operators	1	C-D		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Erwin Kreyszig 10th Edition (2011) – Advanced Engineering Mathematics, Wiley Publishers (International Student Version)
2	Essential Mathematical Methods for the Physical Sciences, K. F Riley, M. P Hobson, 1stEdition, 2011, Cambridge University Press
3	Mathematical Methods In The Physical Sciences, Mary L. Boas, 3 Edition, 2006, Wiley Publication

Course nature			**Theory**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 103	**MECHANICS-I**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Co-requisite:	PHY 103L					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category		CORE	MECHANICS-I			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce the students to the fundamental principles of classical Newtonian dynamics of a system of particles (discrete or continuous) and their general collective behaviors (e.g. surface tension, viscosity).							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Address classical mechanical problems of particles and rigid bodies following Newtonian mechanics							

2.		To solve problems related to classical conservation principles.								
3.		To understand rigid body motions and their conservation principles								
4.		To familiarize with general characterization properties of systems (e.g. surface tension, viscosity).								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I- Newton's Laws of motion (Review)	**9**			
1.	Displacement, Time and Average Velocity, Instantaneous Velocity	1	C		1,2
2.	Average and Instantaneous Acceleration, Motion with Constant Acceleration	1	C		1,2
3.	Velocity and Position by Integration, Position and Velocity Vectors	1	C		1,2
4.	Acceleration Vector (worked examples)	1	C		1,2
5.	Contact Forces, Static friction	1	C		1,2
6.	Kinetic friction	1	C		1,2
7.	Worked examples of static and kinetic frictions	1	C-D		1,2
8.	Free body diagrams and use to Newton's law	1	C-D		1,2
9.	Solution of dynamics with free body diagrams and Newton's law	1	C-D		1,2
	UNIT II – Kinematics	**9**			
10.	Motion of particles in two dimensions	1	C-D		1,2
11.	Motion of particles in three dimensions	1	D		1,2
12.	Tensions and springs, pushing, pulling and tension	1	D		1,2
13.	Solving pulley systems	1	D		1,2
14.	Impulse, conservation of linear momentum	1	C		1,2
15.	Conservation of kinetic and potential energy	1	C		1,2
16.	Uniform circular motion, angular velocity and acceleration	1	C		1,2
17.	Period and Frequency, Newton's Second law and circular motion	1	C		1,2
18.	worked examples – bending of roads, roller coaster motion	1	C		1,2

	UNIT III – Work energy and collision	**9**			
19.	Kinetic Energy and Work in 1D, Work by a Constant Force	1	C		1,2
20.	Work by a Non- Constant Force	1	C		1,2
21.	Conservative and Non-conservative Forces, Path Independence - Gravity	1	C		1,2
22.	Path Dependence – Friction, Potential energy	1	C		1,2
23.	Principle of energy conservation and worked examples	1	C		1,2
24.	Work-Kinetic Energy Theorem in 2D	1	C		1,2
25.	Work-Kinetic Energy Theorem in 3D, worked examples	1	C		1,2
26.	The two-body problem; Collision – elastic and inelastic collisions	1	C		1,2
27.	Collision in 1D and in 2D and worked examples of center of mass and laboratory coordinates	1	C		1,2
	UNIT IV: Rigid body motion	**9**			
28.	Motion of a system of particles, Centre of mass motion, work example – simple collision, projectile fragments	1	C		1,2
29.	Center of mass (derivation in some simple cases - linear distribution of mass, laminar bodies, hemisphere etc.)	1	C		1,2
30.	Variable mass problem (rockets and conveyor belts), conservation principals, energy of system of particles (statements only)	1	C		1,2
31.	Motion of a rigid body, rotation about an axis, Moment of inertia	1	C		1,2
32.	Theorem of parallel and perpendicular axes	1	C		1,2
33.	Calculation of moment of inertia for simple cases (rod, disk, sphere etc.),	1	C		1,2
34.	Compound pendulum	1	C		1,2
35.	Angular momentum and torque of system of particles	1	C		1,2
36.	Conservation of angular momentum and conservation of energy in rigid body rotational motion	1	C		1,2

	UNIT V: General properties of matter	**9**			
37.	Hooke’s law, elastic modulus, relation between elastic modulus, Torsion of a cylinder – torsional pendulum	1	C		1,2
38.	Bending moment Cantilever, worked example - Beam supported at both ends	1	C		1,2
39.	Reciprocity theorem Elastic energy in different types of deformation (Review of concepts)	1	C		1,2
40.	Surface tension - Molecular forces, surface tension and surface energy, Angle of contact	1	C-D		1,2
41.	Excess pressure over a curved liquid surface, Capillarity, Shape of liquid drops. Ripples	1	C-D		1,2
42.	Viscosity of liquids - Streamline and turbulent motion; Reynold’s number, Poiseuille’s equation	1	C-D		1,2
43.	Stoke’s law – worked examples the raindrop falling through atmospheric air and falling of small solids such as stones	1	C-D		1,2
44.	Worked examples: sand, ball bearing through a long column of water	1	C-D		1,2
45.	Equation of continuity; Euler’s equation for liquid flow; Bernoulli’s theorem	1	C-D		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Physics for Scientist and Engineers with Modern Physics, 9rd Edition (2013) – Raymond A. Serway, Clement J Moses and Curt A Moyer (Publisher: Thomson Learning (Asia Region) Singapore)
2	Concepts of Modern Physics (2017)- Arthur Besier, Shobhit Mahajan, S. Rai Choudhury (Tata McGraw Hill)
3	Introduction to classical mechanics, with Problems and Solutions, David Morin, South Asia Edition, 2018, Cambridge University Press

Course nature			**Theory**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
					End semester examination Weightage :	**50%**

PHY 103L	**Laboratory: Mechanics – I**	**L**	**T**	**P**	**C**

		0	0	4	2
Co-requisite:	PHY 103				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category		CORE	CLASSICAL MECHANICS		
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to introduce students about how basic principles of classical mechanics are manifested in real world environment through properly designed experiments.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**							
At the end of the course, student will be able to									
1.	Correlate classical mechanics theories with real life examples								
2.	Analyze experimental data and calculate experimental error								
3.	Handle basic instruments involving linear and rotational motion and simple and compound oscillation								

Sl. No.	**Description of experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Computation methods of data analysis with MS-Excel and Python program and Graphs plotting	4	I,O		1,2
2.	Different statistical methods for Experimental data analysis	4	I,O		1,2
3.	a) Determination of least counts of Vernier caliper b) Determination of length, width and thickness of a metal rod and sheets	4	I,O		1,2
4.	a) Determination of least counts millimeter Screw Gauge instruments b) Determination of radius of a given metal wire	4	I,O		1,2
5.	a) Measure the time period for a given simple pendulum with various lengths b) Determine the value of gravitational acceleration	4	I,O		1,2
6.	a) Measure the time period for a given compound pendulum with various lengths b) Determine radius of gyration of a given pendulum c) Determine the value of gravitational acceleration	4	I,O		1,2
7.	a) Verification of Hooke's Law b) To determine the spring constant	4	I,O		1,2
8.	Measurement of surface tension of different liquids	4	I,O		1,2
9.	To measure the viscosity of a sample liquid based on Stokes' Law	4	I,O		1,2

	Total contact hours (Experiments +Demo + Extra class)	36

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	Hugh D.Young, Roger A. Freedman and Lewis Ford "*University Physics with Modern Physics*" (12th Edition, 2015) –(Publisher – Pearson Education)

Course nature		**Theory**			
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation Note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

SEMESTER-II

FOUNDATION COURSE 3 (FC 3)

FOUNDATION COURSE 4 (FC 4)

PHY 111	**MECHANICS-II**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Co-requisite:	PHY 111L					
Prerequisite:	PHY 103 (Mechanics I)					
Data Book / Codes/Standards	NIL					
Course Category		CORE	MECHANICS-II			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce the students to advanced methods of classical mechanics (Lagrangian and Hamiltonian) and relativistic mechanics							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								

1.		Use tools of classical mechanics tools (Lagrangian and Hamiltonian formalism)								
2.		Solve problems of rigid body dynamics								
3.		Understand the concepts space-time								
4.		To solve problems on relativistic motions								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I- Mechanics of system of particles in different coordinate systems	**9**			
1.	Coordinate systems, Cartesian, Polar	1	C		1,2
2.	Cylindrical and Spherical co-ordinate systems	1	C		1,2
3.	Inertial and Non-inertial frames of references	1	C-D		1,2
4.	Galilean invariance	1	C-D		1,2
5.	Worked examples on Galilean invariance	1	C-D		1,2
6.	Rotating co-ordinate system	1	C-D		1,2
7.	Coriolis's force	1	D		1,2
8.	effect of Coriolis's force on cyclone formation, river flow	1	D		1,2
9.	flight of missiles and freely falling body on Earth's surface	1	D		1,2
	UNIT II – Gravitation and Central force	**9**			
10.	Newton's Law of Gravitation	1	C		1,2
11.	Gravitational potential and intensity: Gauss' theorem	1	C		1,2
12.	Calculation of intensity due to a linear distribution of mass	1	D		1,2
13.	Calculation of potential and intensity due to distribution of masses with cylindrical and spherical symmetry	1	D		1,2
14.	Self-energy of a Sphere	1	D		1,2
15.	Central force, motion under central force	1	C-D		1,2
16.	Conservation of angular momentum	1	C		1,2
17.	Kepler's law of motion	1	C-D		1,2
18.	Deduction of Kepler's laws of planetary motion, orbits of artificial satellite	1	C-D		1,2

	UNIT III – Langrangian and Hamiltonian formulation	**9**			
19.	Limitations of Newtonian formulation	1	C		1,2
20.	Types of constraints, degrees of freedom	1	C		1,2
21.	generalized co-ordinates, configuration space	1	C		1,2
22.	D' Alembert's principle of virtual work	1	C-D		1,2
23.	Langrangian equation from D' Alembert's principle	1	C-D		1,2
24.	cyclic co-ordinates	1	D		1,2
25.	Phase space, Poisson Bracket	1	C		1,2
26.	Hamiltonian's equations	1	C		1,2
27.	worked examples – simple harmonic motions	1	D-I		1,2
	UNIT IV: The kinematics of rigid body motion	**9**			
28.	Rigid body motion	1	C-D		1,2
29.	worked examples on rigid body motion	1	C-D		1,2
30.	spinning top	1	C-D		1,2
31.	Eulerian angles	1	C-D		1,2
32.	worked examples - spinning top	1	C-D		1,2
33.	Angular momentum	1	C-D		1,2
34.	kinetic energy of rotation	1	C-D		1,2
35.	Worked examples on kinetic energy of rotation	1	I		1,2
36.	Review of rigid body motion	1	I		1,2
	UNIT V: The Special Theory of Relativity	**9**			
37.	Concept of space, time and mass (absolute and invariant nature according to Newtonian Mechanics), frames of reference, Newtonian relativity,	1	C		1,2

38.	Galilean transformation and its inverse	1	C		1,2
39.	The need for ether hypothesis, Michelson-Morley Experiment and its result along with explanation provided by MM	1	C		1,2
40.	Fitzgerald and Einstein, Einstein's Postulates	1	C		1,2
41.	Lorentz transformation and its inverse, geometry of relativity (relativity of simultaneity, Lorentz contraction	1	C		1,2
42.	Time dilation, twin paradox, barn and ladder paradox, structure of space-time	1	C-D		1,2
43.	Addition of velocities, concept of expanding universe	1	C		1,2
44.	Relativistic mass (rest mass is least), mass and energy ($E=mc^2$),	1	C-D		1,2
45.	relativistic momentum and energy (massless particle, Compton scattering)	1	C-D		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Reprint edition, 1978, Tata McGraw Hill publishing Company Ltd
2	Classical Mechanics, N. C. Rana, P. S. Joag, Reprint Edition, 1991 Tata Mc Graw Hill Publishing company Ltd.
3	Classical Mechanics, Herbert Goldstein, Reprint Edison, 1998, Narosa Publishing House

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 111L	**Laboratory: Mechanics – II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
Co-requisite:	PHY 111				
Prerequisite:	PHY 103, PHY 103L				

Data Book / Codes/Standards	NIL		
Course Category		CORE	CLASSICAL MECHANICS
Course designed by	Department of Physics		
Approval	-- Academic Council Meeting -- , 2018		

PURPOSE	The purpose of this course is to introduce students about how advanced principles of classical mechanics are manifested in real world environment through properly designed experiments.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	Correlate classical mechanics theories with real life examples							
2.	Do Numerical simulation using Python program							
3.	Handle advanced instruments involving primarily damped and coupled oscillation							
4.	Be able to experimentally calculate important and advanced classical mechanics concepts like Young's modulus, rigidity modulus, moment of inertia etc. of a given material							

Sl. No.	**Description of experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	To calculate the Young's modulus of a given material by deflection method	4	I,O		1,2
2.	To determine the rigidity modulus of the material of the wire by torsional oscillations	4	I,O		1,2
3.	To determine the moment of inertia of a flywheel	4	I,O		1,2
4.	To investigate damped oscillation in air and water	4	I,O		1,2
5.	To determine the coupling factors for a coupling lengths, the angular frequencies or "in-phase" and "in opposite phase" and the beat mode.	4	I,O		1,2
6.	To determine the linear relation between the square of the coupling lengths, beat mode, and the square of the frequency for "in-opposite phase" vibration.	4	I,O		1,2
7.	Numerical integrations and differentiations using python programing	4	I,O		1,2
8.	Numerical integration of equations of motion for charge particles in electric and magnetic fields	4	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	32			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	Hugh D.Young, Roger A. Freedman and Lewis Ford "*University Physics with Modern Physics*" (12th Edition, 2015) –(Publisher – Pearson Education)

Course nature				**Theory**	
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation Note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

PHY 115	**ELECTRICITY AND MAGNETISM**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Co-requisite:	PHY 115L					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category		CORE	ELECTRICITY AND MAGNETISM			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce the students to electrostatic, magneto-statics and electrodynamics in problems commonly encountered.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the behavior of electric charges and their interactions with magnetism							
2.	Behavior of electric and magnetic fields in materials							
3.	AC circuit elements and their behavior							

4.	Applications of AC circuits							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I- Electrostatics	**9**			
1.	Concept of electric field	1	C		1,2
2.	Coulomb's law	1	C		1,2
3.	Superposition principle	1	C		1,2
4.	Electric field due to point charge	1	C		1,2
5.	Electric field due to group of charges	1	C		1,2
6.	Electric field due to continuous charge distribution	1	C		1,2
7.	Concept of electric flux, Gauss's theorem in electrostatics with examples	1	C		1,2
8.	Electric intensity and electric potential	1	C		1,2
9.	Energy of the system of point charges and charge distribution – worked examples	1	C-D		1,2
	UNIT II – Boundary value problems in Electrostatics	**9**			
10.	Solution field distribution of boundary value problems	1	D-I		1,2
11.	Rectangular symmetric problems	1	D-I		1,2
12.	spherical symmetric systems	1	C-D		1,2
13.	Worked examples of boundary value problems	1	D-I		1,2
14.	Problems with azimuthal symmetry	1	I		1,2
15.	Problems with circular symmetry	1	I		1,2
16.	Problems with spherical symmetry	1	I		1,2
17.	conducting sphere in a uniform field	1	C		1,2
18.	Review of boundary value problems	1	C		1,2
	UNIT III – Electric dipole, dipole moment and quadrupoles	**9**			
19.	Electric potential due to dipole	1	C		1,2
20.	Electric field intensity due to dipole	1	C		1,2
21.	Torque on electric dipole in external electric field	1	C		1,2

22.	worked examples – polar molecules	1	I		1,2
23.	Effect of external electric field on non-polar molecules	1	C		1,2
24.	induced dipole moment	1	C		1,2
25.	Dipole-dipole interaction in a plane, out of plane and positioned at certain angle	1	C		1,2
26.	Dipoles in Uniform and non-uniform electric field	1	C		1,2
27.	Quadrupole Moment, Potential near an Arbitrary Charge Distribution, Two Simple Quadrupoles, Octuplet Moment	1	C		1,2
	UNIT IV: Dielectric materials	**9**			
28.	Polar and non-polar molecules	1	C		1,2
29.	atomic polarizability, worked examples	1	C		1,2
30.	Electric polarization of dielectric material	1	C		1,2
31.	Electric polarization vector, Strength of dielectric material and Dielectric breakdown	1	C		1,2
32.	Electric displacement and Gauss law in dielectric, Relation between three electric vectors (E, D and P)	1	C		1,2
33.	Plane Parallel Capacitor, Capacitor filled with dielectric	1	C		1,2
34.	Coaxial Cylindrical Capacitor, Concentric Spherical Capacitor	1	C		1,2
35.	Capacitors in Parallel, Capacitors in Series	1	C		1,2
36.	Dielectric material in an alternating electric field	1	C		1,2
	UNIT V: Alternative current and transient circuit	**9**			
37.	A.C. Theory: Alternating currents	1	C		1,2
38.	basic ideas of generation, mean and r.m.s. values	1	C		1,2
39.	Response of circuits containing L, C and R to step input and pulses, transients	1	D		1,2
40.	Use of complex numbers, R, L, C, RL, RC, circuits	1	D		1,2
41.	phase diagrams, power factor	1	D		1,2
42.	LCR circuit, series and parallel resonance, bandwidth and Q-value	1	D		1,2
43.	Losses in A. C. circuits, the skin effect	1	D		1,2
44.	AC Bridges, Owen Bridge, Schering Bridge, Wien Bridge	1	D		1,2

45.	Bridge Solution by Delta-Star Transform	1	D		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Introduction to Electrodynamics, David J. Griffiths, 4/e Edition, 2015, Pearson Publication
2	Electricity and Magnetism (In Si Units): Berkeley Physics Course - Vol.2 Edward Purcell 2017, McGraw Hill Education
3	Classical Electrodynamics, John David Jackson, 3 Edition 2007, Wiley

Course nature		**Theory**				
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 115L	**Laboratory: Electricity and Magnetism**		**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**
Co-requisite:	PHY 115					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category	CORE	Electricity and Magnetism				
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to train students to determine crucial electrical parameters of various electro-magnetic circuit elements like capacitor, inductor and resistor.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**					
	At the end of the course, student will be able to						
1.	Correlate electricity & magnetism theories with real life examples						
2.	Study and calculate electrical parameters of capacitor, inductor and resistor etc.						
3.	Design, fabricate and study series and parallel circuits involving						

	capacitor, inductor and resistor.								

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	a) To use a multimeter for measuring Resistances, A/C and DC Voltages, AC and DC Currents, Capacitances, and Frequencies b) Determine electrical parameters of commercially available electronic components	4	I,O		1,2
2.	To determine the capacitance of a parallel plate capacitor by the measurement of charge. To measure the capacitance as a function of area and distance between the plates.	4	I,O		1,2
3.	To determine the dielectric constant of different dielectric materials	4	I,O		1,2
4.	To determine the value of High Resistance by Leakage Method	4	I,O		1,2
5.	To study the response curve of a Series LCR circuit and determine its (a) Resonant Frequency, (b) Impedance at Resonance and (c) Quality Factor Q, and (d) Band Width	4	I,O		1,2
6.	To study the response curve of a Parallel LCR circuit and determine its (a) Anti-Resonant Frequency and (b) Quality Factor Q	4	I,O		1,2
7.	To find the mutual inductance of two coils	4	I,O		1,2
8.	To study the working of step-down/step-up transformer	4	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	32			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	Hugh D.Young, Roger A. Freedman and Lewis Ford "*University Physics with Modern Physics*" (12th Edition, 2015) –(Publisher – Pearson Education)
4	David J. Griffiths, "*Introduction to Electrodynamics*", 4/e Edition, 2015, Pearson Publication

Course nature	**Theory**
Assessment Method (Weightage 100%)	

In-semester	Assessment tool	Experiments	Record/ Observation Note	Viva Voce + Model examination	Total
	Weightage	20%	10%	20%	50%
End semester examination Weightage :					50%

ENV 100	ENVIRONMENTAL SCIENCE		L 4	T 0	P 0	C 4
Co-requisite:	NIL					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category	F	FOUNDATION CORE	ENVIRONMENTAL SCIENCE			
Course designed by	Department of Environmental Science					
Approval	--					

PURPOSE	The course aims to provide integrated, quantitative and interdisciplinary approach for understanding environmental issues and finding lasting solutions. Environmental disasters/issues faced by humanity in the past and present were used to illustrate the possible, sustainable solution.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand what sustainability is and the importance of sustainable solutions to environmental problems							
2.	Know the components of an ecosystem and how they play an important role in matter cycling.							
3.	Feel the importance of biodiversity and the consequences of declining biodiversity							
4.	Inculcate the concepts of environmental ethics while trying to resolve environmental issues and understand the policies that help in it.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: ENVIRONMENTAL EDUCATION & SUSTAINABILITY	**3**			1
1.	What is environmental education (EE)? The evolution of EE	1	C	1-4	1
2.	Principles of Sustainability	1	C	1	1,2
3.	Sustainable technologies	1	C	1	2

	UNIT II: ECOLOGICAL SYSTEM	**10**			
4.	Earth Systems - atmosphere	2	C,D	2,3	1
5.	Earth Systems - Hydrosphere	1	C,D	2,3	1
6.	Earth Systems - Lithosphere	1	C,D	1,2,3	1
7.	Earth Systems - Biosphere	1	C,D	2,3	1
8.	Ecosystems - Structure and Function	1	C,D	1,2	1
9.	Major Biomes	2	C,D	2	1
10.	Water, nutrients (phosphorous, nitrogen) and Carbon cycles	2	C,D	2	1
	UNIT III: ENVIRONMENTAL POLLUTION- its role on global climate change and human health	**9**			
11.	Air pollution – composition of air, sources of pollution and their classification	2	C,D	3	2
12.	Air pollutants – classifications	2	C,D	3	2
13.	Air Quality Index (AQI)	1	C,D	3	2
14.	Air pollution control devices	1	C,D	3	2
15.	Water pollution - Water sources, use and classifications	1	C,D	3	2
16.	Water pollutants	1	C,D	3	2
17.	Water pollution control devices	1	D,I	3	2
	UNIT IV: BIODIVERSITY & ITS CONSERVATION	**9**			
18.	Biodiversity – definition and types	1	C	2	2,3
19.	Concepts of species richness, evenness, and their regulation. Species diversity cline	1	C	2	3
20.	Island biogeography – equilibrium model Vulnerability of island species	1	C	3	3
21.	Conservation Biology – Historical perspective of extinction Difference between past extinction and present	1	C,D	3	1
22.	Biodiversity Hotspots – global distribution	1	C,D	3	1
23.	Values of Biodiversity – Why do we care?	1	C,D	3	2
24.	World’s Biodiversity is in serious trouble – frogs as global “canaries of mines”	1	C,D	3	2
25.	Human impacts on biodiversity – Habitat destruction, Pollution, Ecosystem disruption, Habitat	1	C,D	3	2

	fragmentation , over exploitation, and introduction of invasive species				
26.	Preservation of endangered species	1	I	3	2
	UNIT V: ENVIRONMENTAL ETHICS, ECONOMICS, AND POLICY	**9**			
27.	Concepts of Sustainable ethics – Frontierism, Leopold's Land Ethics, and transition to Sustainable ethics	1	C	4	2
28.	Principles of Sustainable ethics, Frontier ethics vs sustainable ethics	1	C	4	2
29.	Developing and implementing sustainable ethics and overcoming the obstacles of sustainable ethics, utilitarianism and natural rights	1	C	4	2
30.	Fundamentals of Environmental Economics – concepts of resources, Capital, Supply, Demand, and Market equilibrium , Classical Economics, Neoclassical economics, Ecological Economics and Externalization of costs	1	C	4	2,4
31.	Ecosystem Services – Can we internalize all costs?	1	C	4	2,4
32.	Resource depletion, Hubbert Curve, and Carbon bubble, Scarcity and innovation, Economic models for growth	1	C	4	2,4
33.	Measuring growth – GNP, GDP, GPI, Cost-Benefit Analysis. Can market reduce pollution ?– Carbon credit	1	C	4	2,4
34.	Environmental Policies – international laws and polices	1	C,D	4	1
35.	Environmental Laws and Policies of India	1	C,D	4	1
	Total contact hours	40			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Basu. M, Xavier. S. "*Fundamentals of Environmental Studies*", 1st edition, Cambridge University Press, 2016
2	Danial. D. C. "*Environmental Science*", 8th edition, Jones and Barlett Publishers, MA, 2010.
3	Raven P. Biology – 11th Edition, McGraw hill
4	Cunningham and Cunningham. Environmental Science – A global concern Tata McGraw-Hill Education India

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment**	Midterm	Midterm	Quiz	Internal Project	**Total**

	tool	Exam I	Exam II			
	Weightage	**12%**	**12%**	**11%**	**15%**	**50%**
End semester examination Weightage						**50%**

SEMESTER-III

FOUNDATION COURSE 5 (FC 5)

PHY 201	**WAVES, OSCILLATIONS, AND OPTICS**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Co-requisite:	PHY 201L					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category		CORE	SLAB			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to understand the physics behind various phenomena associated with oscillations, waves and optical instruments.								
LEARNING OBJECTIVES		**STUDENT OUTCOMES**							
At the end of the course, student will be able to									
1.	Address different types of oscillations and its various applications								
2.	Understand transverse and longitudinal waves and their propagation								
3.	Learn Doppler'e effect and its applications								
4.	Gain the basic principles of several optical instruments								

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	Unit -1: Undamped and Damped Oscillations	**9**			
1.	Different types of equilibria (stable, unstable, neutral equilibrium, Saddle points)	1	C		1-7
2.	Definition of linear and angular S.H.M	1	C		1-7

3.	Differential equation of S.H.M. and its solution (exponential form)	1	C		1-7
4.	Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method)	1	C		1-7
5.	Lissajous's figures and its uses	1	D,I		1-7
6.	Lissajous's figures and its Applications (mechanical, electrical and optical)	1	D,I		1-7
7.	Differential equation of damped harmonic oscillator and its solution, discussion of different cases	1	C,D		1-7
8.	Logarithmic decrement, Energy equation of damped oscillations	1	C,D		1-7
9.	Power dissipation, Quality factor	1	C,D		1-7
	Unit – II: Forced Oscillations	**9**			
10.	Forced oscillation with one degree of freedom	1	C		1-7
11.	Differential equation of forced oscillation and its solution (transient and steady state)	1	C,D		1-7
12.	Amplitude of forced oscillation	1	C		1-7
13.	Resonance and its examples: mechanical (Barton's pendulum)	1	C,I		1-7
14.	Resonance and its examples: optical (sodium vapor lamp), electrical (LCR Circuit) (description only)	1	C,I		1-7
15.	Velocity and Amplitude resonance, Sharpness of resonance	1	C		1-7
16.	Energy of forced oscillations, Power dissipation	1	C		1-7
17.	Quality factor and Bandwidth	1	C		1-7
18.	Equation of coupled oscillations, electrically coupled oscillations	1	C,D		1-7
	UNIT III - Wave Motion	**9**			
19.	Differential equations of wave motion in continuous media	1	C		1-7
20.	Equations for longitudinal waves	1	C		1-7
21.	Equations for longitudinal waves and one dimension solution	1	C		1-7

22.	Equation for transverse waves	1	C		1-7
23.	Equation for transverse waves and its solution (one dimension only)	1	C		1-7
24.	Wave propagation in solid, liquid, gases	1	C		1-7
25.	Wave propagation in solid, liquid, gases, and its solution	1	C		1-7
26.	Energy density and intensity of a wave	1	C		1-7
27.	Discussion of seismic waves	1	C,D		1-7
	UNIT IV: Sound and Doppler Effect	**9**			
28.	Definition of sound intensity, loudness, pitch, quality and timber	1	C		1-7
29.	Interference of sound waves, beats, combination	1	C,D		1-7
30.	Application of Fourier's series to the vibration of strings-struck and plucked strings, Energy of a vibration string	1	C,I		1-7
31.	Acoustic intensity level measurement, Acoustic pressure and it's measurement- The Helmholtz resonator; The Kundt's tube	1	C,I		1-7
32.	Sabine's formula (without derivation), Stroboscope	1	C,D		1-7
33.	Waves generated by high-speed projectiles, Shock waves	1	C,D		1-7
34.	Explanation of Doppler Effect in sound, Expression for apparent frequency in different cases	1	C,D		1-7
35.	Doppler Effect in light, symmetric nature of Doppler Effect in light	1	C,D		1-7
36.	Applications: Red shift, Violet shift, Radar, Speed trap, Width of a spectral line	1	I,O		1-7
	UNIT V: Geometrical Optics	**9**			
37.	Fermat's principle and its application to reflection and refraction at plane and spherical surfaces	1	C,D		1-7
38.	Dispersive power of prisms, angular magnification	1	C,D		1-7

39.	Cardinal points of optical systems, Paraxial optics and matrix method of evaluation of cardinal points and lens equations	1	C,D		1-7
40.	Helmholtz-Lagrange Law; Combination of lenses and equivalent lens	1	C,D		1-7
41.	The matrix method in paraxial optics	1	C,D		1-7
42.	Qualitative discussions of aberrations, Chromatic aberration and achromatic combination of lenses	1	C,D		1-7
43.	Optical Instruments - Simple microscope and Compound microscope	1	C,D		1-7
44.	Telescopes, Reflection and transmission type of telescope	1	D,I		1-7
45.	Eyepieces: Huygen's eyepiece, Ramsden's eyepiece, Gauss's eyepiece	1	D,I		1-7
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Advanced Acoustics D. P. Roy Chowdhury, Reprint Edition, 2015, Chayan Publisher
2	Vibrations and Waves, Anthony Philip French, reprint Edition, 1971, Nelson
3	Introduction to Geometrical and Physical Optics, B. K. Mathur, 7 Edition, 1967, Gopal Printing
4	Fundamentals of Optics, Francis Jenkins, Harvey White, 4 edition, 2017 McGraw Hill
5	Waves Oscillations and Acoustics, Kakani S.L., 2 Edison, 2018, CBS Publishers & Distributors
6	Textbook of sound A. B. Wood, 2 Edison, 1941, London, G. Bell and sons, ltd.
7	A Textbook on Light, K G Mazumdar and B Ghosh, 3rd revised Edition, 2010, Sreedhar

Course nature		**Theory**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 201L	Laboratory: Oscillations, Waves and Optics		L	T	P	C
			0	0	4	2
Co-requisite:	PHY 201L					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category		CORE	Oscillations, Waves and Optics			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce students about how principles of waves & oscillations are manifested in real world environment through properly designed experiments.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand crucial concepts of waves & oscillations like damped oscillation, forced oscillations and resonance through examples and experiments.							
2.	handle and utilize a telescope							
3.	handle and utilize a prism and find its various optical properties like angle of deviation (i) – deviation (D) , Refractive Index, dispersion power etc.							

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	To investigate the damping effect of an oscillating spring in high viscosity liquid like oil or glycerine.	4	I,O		1,2
2.	To investigate resonance in forced oscillations	4	I,O		1,2
3.	To determine particle size of a given powder using wave optics method	4	I,O		1,2
4.	To determine the resolving power of a telescope	4	I,O		1,2

5.	Determine angle of deviation (i) – deviation (D) of a given prism.	4	I,O		1,2
6.	To determine the Refractive Index of the Material of a given Prism using Sodium Light.	4	I,O		1,2
7.	To determine the dispersion power of a prism material	4	I,O		1,2
8.	To Determine Cauchy's A and B constant with μ $vs. 1\lambda 2⁄$ graph.	4	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	32			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	Hugh D.Young, Roger A. Freedman and Lewis Ford "*University Physics with Modern Physics*" (12th Edition, 2015) –(Publisher – Pearson Education)

Course nature				**Theory**	
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation Note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

SRM UNIVERSITY AP
Andhra Pradesh

PHY 202	HEAT AND THERMODYNAMICS	L	T	P	C
		3	0	0	3
Co-requisite:	PHY 202L				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	CORE	SLAB			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	This course will help the students to gain the basic knowledge on the fundamental laws of thermodynamics and their applications.

LEARNING OBJECTIVES	STUDENT OUTCOMES						
At the end of the course, student will be able to							
1. Address the ideal gas equation and the law of partition energy							
2. Analyze the basic concepts behind the various laws of thermodynamics							
3. Discuss the various thermodynamic relations							
4. Understand the concept of thermoelectricity							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I - Kinetic Theory of Gases	**9**			
1.	Assumptions of Kinetic Theory of gases, Pressure of an ideal gas (no derivation)	1	C		1-5
2.	Kinetic interpretation of Temperature, Ideal Gas	1	C		1-5
3.	Degree of freedom, Law of equipartition of	1	C-D		1-5
4.	Brownian motion (qualitative), Real gases,	1	C-I		1-5

5.	Vander Waal's equation of ideal gases,	1	C		1-5
6.	Maxwell distribution of gas molecules speed (derivation)	1	D		1-5
7.	Experimental verification of Maxwell's Law of	1	I		1-5
8.	Most probable speed, average and root mean	1	D		1-5
9.	Transport of energy and momentum, diffusion	1	C		1-5
	UNIT II – Basic Concepts of	**9**			
10.	Thermodynamic state of a system, Thermal Equilibrium	1	C		1-5
11.	Zeroth law of Thermodynamics	1	C		1-5
12.	Internal Energy of System-Concept of heat and	1	C		1-5
13.	Equation of State: The Ideal Gas Equation,	1	C		1-5
14.	First law of Thermodynamics	1	C-D		1-5
15.	Thermodynamic Process-Isothermal, Adiabatic, Isobaric, Isochoric	1	C-D		1-5
16.	Adiabatic relations of system for perfect gas	1	C-D		1-5
17.	Work done during Isothermal and Adiabatic changes	1	C-D		1-5
18.	Reversible and Irreversible processes in	1	C-D		1-5
	UNIT III - Second Law of Thermodynamics: Entropy	**9**			
19.	Conversion of Heat into Work and its converse	1	C		1-5
20.	Carnot's Cycle and Carnot's Heat Engine and its	1	C-D		1-5
21.	Second law of Thermodynamics: Statements,	1	C		1-5
22.	Entropy, Principle of Increase in Entropy	1	C		1-5
23.	Generalised form of the First and Second laws	1	D		1-5
24.	Entropy changes for an Ideal Gas	1	D		1-5
25.	Entropy changes for van der Waals' gas	1	D		1-5
26.	Otto cycle, Diesel cycle and its comparison,	1	I-O		1-5

27.	The Carnot Refrigerator, Air conditioning:	1	I-O		1-5
	UNIT IV: Equation of state and Thermodynamic relations	**9**			
28.	Equilibrium between two phases; General equilibrium conditions	1	C		1-5
29.	The Clausis-Clapeyron equation	1	C-D		1-5
30.	Chemical thermodynamics; Thermodynamic functions for as mixture of ideal gases	1	C-D		1-5
31.	Chemical potential	1	C		1-5
32.	Legendre transformations of thermodynamic potentials	1	C-D		1-5
33.	Legendre transformations of thermodynamic potentials, worked examples	1	C		1-5
34.	Thermodynamic description of Phase Transition	1	C		1-5
35.	Thermodynamic description of phase diagrams	1	C		1-5
36.	The Liquid–Gas Transition in Simple Liquids i.e. water	1	C-D		1-5
	UNIT V: Thermoelectric effect	**9**			
37.	Seebeck effect	1	C		1-5
38.	Peltier effect	1	C		1-5
39.	Thomson effect	1	C		1-5
40.	Full thermoelectric equations	1	D		1-5
41.	Thomson relations	1	D		1-5
42.	Thermoelectric generators	1	I		1-5
43.	Applications of Thermoelectric generators and its applications	1	I		1-5
44.	Thermocouples, Temperature measurement	1	I-O		1-5
45.	Thermoelectric materials	1	I		1-5

	Total contact hours	45

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	University Physics with Modern Physics with Mastering Physics, (12th Edition, 2015) – Hugh D.Young, Roger A. Freedman and Lewis Ford (Publisher – Pearson Education)
2	Heat and Thermodynamics, Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, (2015) McGraw-Hill International Editions.
3	Heat and Thermodynamics, Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
4	Concept of Physics, H.C. Verma, Bharati Bhavan Publishers.
5	Thermal Physics (Heat & Thermodynamics), A.B. Gupta, H.P. Roy, (Revised Edison 2010) Books and Allied (P) Ltd, Calcutta.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
					End semester examination Weightage :	**50%**

PHY 202L	Laboratory: Heat and Thermodynamics	L	T	P	C
		0	0	4	2
Co-requisite:	PHY 202				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	CORE	Heat and Thermodynamics			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to train students to experimentally measure various thermodynamic parameters of matter in solid and liquid state of matter. Also this course will train them to fabricate thermo-couple circuit and how to utilize it for various applications.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	Determine important thermodynamic properties like thermal conductivity, coefficient of thermal expansion, specific heat capacity of a given unknown solid.							
2.	Determine boiling point of an unknown liquid (using platinum resistance thermometer).							
3.	Fabricate a Thermocouple circuit and utilize it to measure Thermo-EMF of a thermocouple and temperature of an unknown thermo-couple.							

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	To study the thermal conductivity of a given material in a constant temperature gradient	4	I,O		1,2

2.	Determine the specific heat capacity of given metal and insulating materials by heat exchange method	4	I,O		1,2
3.	Measurement of Joule's constant (J) by electrical method	4	I,O		1,2
4.	To find coefficient of thermal expansion of copper, aluminum and brass using their pipes	6	I,O		1,2
5.	Determination of the boiling point of a liquid by platinum resistance thermometer	4	I,O		1,2
6.	a) Development of Thermocouple circuit using commercially available thermocouple b) To study the variation of Thermo-EMF of a thermocouple with Difference of temperature of its two junctions	6	I,O		1,2
7.	Determination of the unknown temperature by thermocouple	4	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	36			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	Hugh D.Young, Roger A. Freedman and Lewis Ford "*University Physics with Modern Physics*" (12th Edition, 2015) –(Publisher – Pearson Education)

Course nature		**Theory**			
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation Note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

Allied Subject: Chemistry-1

Mathematics 1/Biology-1/Economics-1	Mathematics 1/Biology-1/Economics-1

Allied Subject: Chemistry-1

CHE111	**Principles of Chemistry-1a**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**

Co-requisite:	NIL		
Prerequisite:	NIL		
Data Book / Codes/Standards	NIL		
Course Category	P	PROFESSIONAL CORE	GENERAL CHEMISTRY
Course designed by	Department of Chemistry		
Approval	-- Board of Studies Meeting -- , 2018		

PURPOSE	The course provides an over view of general concept of chemical bonding and will discuss coordination bonding in chemistry with practical application. In addition, the course will provide basic introduction of fundamental physical chemistry such as thermodynamics, phase rule, chemical kinetics. Finally, the properties of crystalline materials will be covered. In short, throughout this course, the fundamental concepts will be illustrated by the recent examples along with the contemporary knowledge								
LEARNING OBJECTIVES			**STUDENT OUTCOMES**						
At the end of the course, student will be able to									
1.	Address the different properties of chemical bonding								
2.	Know which are the coordination compounds								
3.	Develop a deep knowledge about thermodynamics, phase rule, chemical kinetics and crystalline materials.								
4.	Learners should be able to provide physical explanation in key concepts of bonding and basic physical chemistry.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I - CHEMICAL BONDING	**6**			
1.	Ionic, covalent, and metallic bonds. Theories of bonding: Valence bond theory, nature of covalent bond, sigma (σ) bond, Pi (π) bond.	1	C		1
2.	Non-covalent interactions: Van der Waals interactions, dipole-dipole interactions, and hydrogen bonding. Hybridization: Types of hybridization, sp, sp2, sp3, sp3d, d2sp3.	1	C		1
3.	Shapes of molecules (VSEPR Theory): $BeCl_2$, CO_2, BF_3, H_2O,	1	C		1,3
4.	Shapes of molecules (VSEPR Theory): NH_3, CH_4, PCl_5, XeF_2, SF_6, XeF_4.	1	C		1,3
5.	Molecular orbital theory: Linear combination of atomic orbitals (LCAO Method), bond order,	1	C		1,3
6.	homo- (H_2, O_2, N_2) and heteronuclear diatomic Molecules (NO, CO).	1	C		1,3

	UNIT-II: COORDINATION CHEMISTRY	**6**			
7.	Werner's theory, valence bond theory (inner and outer orbital complexes), EAN rule,	1	C		2,4
8.	Crystal field theory, measurement of 10 Dq (Δo)	1	C		2,4
9.	CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt).	1	C		2,4
10.	Octahedral vs. tetrahedral coordination, Qualitative aspect of Ligand field and MO Theory.	1	C		2,4
11.	IUPAC nomenclature of coordination compounds, isomerism in coordination compounds.	1	C		2,4
12.	Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, Labile and inert complexes.	1	C		2,4
	UNIT-III: INTRODUCTION TO THERMODYNAMICS	**10**			
13.	Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.	2	C		1,3
14.	*First law:* Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities,	2	C		1,3
15.	Calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.	1	C		1,3
16.	*Second Law:* Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics;	2	C		1,3
17.	Molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.	1	C		1,3
18.	*Third Law:* Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.	2	C		1,3
	UNIT IV – PHASE RULE AND KINETICS	**8**			
19.	Phase rule: Introduction. Definition of the terms used in phase rule with examples.	3	C,D		2,4
20.	Application of phase rule to water system, sulphur system and lead-silver system.	2	I		2,4
21.	Kinetics: Order and molecularity of reactions, zero order	1	C		2,4
22.	First order and second order reactions.	2	C		2,4
	UNIT V. CRYSTALLINE MATERIALS	**10**			

23.	Crystal structure: crystal systems, Bravais lattices,	3	C		1,3,4
24.	Miller indices.	1	C		1,3,4
25.	Properties of cubic crystals.	2	C		1,3,4
26.	X-ray diffraction.	1		C	1,3,4
27.	Defects: point, line, surface and bulk.	3		C	1,3,4
	Total contact hours	40			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	• Peter, A. & Paula, J. de. *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2	• Inorganic Chemistry: Mark Weller, Tina Overton, Jonathan Rourke, and Fraser Armstrong, 6th edition, Oxford University Press, 2014.
3	• Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
4	• Inorganic Chemistry: J.E. Huheey, E.A. Keiter and R.L. Keiter (2007) 4th edition, Pearson Education.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

Allied Subject: Computer-1

CSE 101	**Introduction to Computer Science and Programming**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**
Co-requisite:	NIL				
Prerequisite:	NIL				

Data Book / Codes/Standards	NIL		
Course Category		Core Course	Engineering Science
Course designed by	Department of CSE		
Approval	-- Board of Studies -- , 2018		

PURPOSE	The course aims to provide ability to design algorithmic solutions to problems and convert algorithms to Python programs. Design modular programs using functions and develop recursive solutions. Provide ability to design programs with interactive input and output, utilizing arithmetic expression repetitions, decision making and design object-oriented solutions. To analyse the computational complexity of the programs.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn basics of programming knowledge in Python							
2.	The course is designed to get the knowledge of developing problem solving skills using Python							
3.	Decision making and functions in python.							
4.	To introduce basic concepts of object-oriented design technique							
5.	To introduce the concept of computational complexity							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Python	**9**			
1.	Knowledge, Machines, Languages,	1	C		1
2.	Types, Variables Operators and Branching	1	D		
3.	**Core elements of programs**: Bindings, Strings, Input/Output, IDEs,	1	C		1

4.	Input/Output, IDEs		I		
5.	Control Flow, Iteration, Guess and Check –	1	C		1
6.	**Simple Programs**: Approximate Solutions,	1	I,O		1
7.	Bisection Search,	1	I,O		1
8.	Floats and Fractions,	1	I,O		1
9.	Newton-Raphson.	1	I,O		1
	Unit II	**9**			
10.	**Functions**: Decomposition and Abstraction	1	C		1
11.	Functions and Scope,	1	C		1,2
12.	Keyword Arguments, Specifications,	1	C,D		1,2
13.	Iteration vs Recursion,	1	C,D		1,2
14.	Inductive Reasoning,	1	C,D		1
15.	Towers of Hanoi,	1	C,D		1,2
16.	Fibonacci,	1	I		
17.	Recursion on non-numeric,	1	I		
18.	Files	1	I		
	UNIT III –	**9**			
19.	**Tuples and Lists**: Tuples, Lists, List Operations, –	1	C		1
20.	Mutation, Aliasing, Cloning	1			1
21.	**Dictionaries**: Functions as Objects, Dictionaries ,	1			1
22.	Example with a Dictionary, Fibonacci and Dictionaries,	1			1
23.	Global Variables	1			1
24.	**Debugging**: Programming Challenges	1			
25.	Classes of Tests, Bugs, Debugging, Debugging Examples–	1			1

26.	**Assertions and Exceptions,** Assertions, Exceptions,	1			
27.	Exception Examples	1			
	UNIT IV:	9			
28.	**Classes and Inheritance**	1			4
29.	: Object Oriented Programming,	1			4
30.	Basic Concept of Object, Class, Inheritance, Polymorphism	1			4
31.	Class Instances, Methods Classes Examples ,	1			4
32.	Why OOP, Hierarchies, Your Own Types – **An Extended Example**: Building a Class,	1			
33.	Visualizing the Hierarchy	1			
34.	Adding another Class, Using Inherited Methods,	1			
35.	Gradebook Example, Generators	1			
	UNIT V:	**9**			
36.	**Computational Complexity**:	1			2
37.	Program Efficiency, Big Oh Notation,	1			2,4
38.	Complexity Classes Analyzing Complexity –	1			2
39.	**Searching and Sorting Algorithms**:	1			2,4
40.	Introduction on search and sorting	1			
41.	Linear Search,	1			
42.	Bisection Search,	1			
43.	Bogo and Bubble Sort,	1			
44.	Selection Sort, Merge Sort	1			

	Total contact hours	45

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)
2	Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher EducationOxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
3	Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher(2016)
4	Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition(6th February 2009)

Lab Assignments	
1	A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2	Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3	Write a Python program to find the factorial of the given number (Example : 5!= 5*4*3*2*1 =120)
4	Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
5	Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6	Write a python program for bubble sort algorithm. What is the best case and worst case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7	Write a python program for Selection sort algorithm. What is the worst case or

	average case time complexity of selection sort algorithm?
8	Write a Program in python using object oriented concept to make calculator which has the following operations: Addition , Subtraction, Multiplications, Divisions, Exponentials, Modulus
9	Define is inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10	Write a Program in python using object oriented concept to create a base class called **Polygon** and there are three derived classes named **as triangle, rectangle** and **square**. The base class consists of the **input function** for accepting sides length and the derived classes must have **output function** for displaying area of triangle, rectangle and square.

Course nature							**Theory and Lab**
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignments	Lab Performance	Quiz	**Total**
	Weightage **Theory**	**15%**	**15%**	**5%**	**10%**	**5%**	**50%**
End semester examination Weightage :							**50%**

SEMESTER-IV

FOUNDATION COURSE 5 (FC 5)

PHY 212	BASIC ELECTRONICS	L	T	P	C
		3	0	0	3
Co-requisite:	PHY 212L				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	CORE	SLABS			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to introduce students about the basic electronics and electronic devices.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Know the concept of band gap in semiconductors.							
2.	Design op-amps, adders and oscillators for a variety of applications							
3.	Understand rectifiers, filters							
4.	Design different circuits using logic gates							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT I - Semiconductor Fundamentals	**9**			
1.	Types of solids	1	C		1-4
2.	Semiconducting materials: Introduction	1	C		1-4
3.	Semiconducting materials: Types	1	C		1-4
4.	Conduction energy band valance energy band	1	C		1-4
5.	Origin of band gap	1	C		1-4
6.	Doping of semiconductor	1	C		1-4
7.	p type semiconductor	1	C		1-4
8.	n type semiconductor	1	C		1-4
9.	Energy levels of doped semiconductors	1	C		1-4

	UNIT II – Analog electronics	**9**			
10.	P-n junction diodes and equivalent circuit	1	C		1-4
11.	Zener diodes and its applications	1	C		1-4
12.	Clipping and clamping application	1	I		1-4
13.	Bipolar junction transistor, types	1	C-D		1-4
14.	Symbols and basic configurations (Common Base, Common Emitter & Common Collector)	1	C		1-4
15.	Definition of alpha, beta and their relations	1	C		1-4
16.	Input, output and transfer characteristics of CE and CB configurations	1	C-D		1-4
17.	AC and DC load lines	1	C		1-4
18.	operating point (Q point)	1	C		1-4
	UNIT III - Operational Amplifiers and Oscillators	**9**			
19.	Positive and negative feedback, four types of negative feedback	1	C-D		1-4
20.	Operational amplifier: IC 741- Block diagram, Characteristics: ideal and practical	1	C-D		1-4
21.	Concept of virtual ground	1	C		1-4
22.	Inverting and non-inverting operational amplifiers with concept of gain	1	C-D		1-4
23.	Operational amplifier as an adder, subtracted and other examples	1	C-D		1-4
24.	Oscillators: concept of positive and negative feedback	1	C-D		1-4
25.	Barkhausein criteria**,** Phase shift oscillator and Wien bridge oscillator (Derivation for frequency and feedback factor for both oscillators)	1	C-D		1-4
26.	Power amplifiers	1	C-D		1-4
27.	Class A / B / C and operators	1	C		1-4
	UNIT IV: Power Supplies	**9**			
28.	Half wave, Full wave rectifier	1	C-D		1-4
29.	Ripple factor	1	D		1-4

30.	Bridge rectifier	1	D		1-4
31.	Capacitor filter	1	D		1-4
32.	Difference between regulated and unregulated power supply	1	D-I		1-4
33.	Definition of Line and Load regulation	1	D		1-4
34.	Series and Shunt regulators- Block diagram and circuit of regulated power supply using discrete components	1	D-I		1-4
35.	Simple current limiting circuit	1	D-I		1-4
36.	Design of a regulated DC power supply	1	D-I		1-4
	UNIT V: Digital Electronics	**9**			
37.	Number systems: Binary, Binary coded decimal (BCD), Octal, Hexadecimal	1	C-D		1-4
38.	Addition and subtraction of binary numbers and binary fractions	1	C-D		1-4
39.	Basic logic gates: OR, AND, NOT	1	C-D		1-4
40.	Derived gates: NOR, NAND, EXOR, EXNOR with symbols and truth tables	1	C-D		1-4
41.	Boolean algebra	1	C-D		1-4
42.	Boolean Equations	1	C-D		1-4
43.	De Morgan's theorems and its verification	1	D		1-4
44.	Introduction to ROM, RAM, and PROM	1	C		1-4
45.	Introduction to EPROM, and EEPROM	1	C		1-4
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Electronic Devices and Circuit Theory: Robert L. Boylestad and Louis Nashelsky (2015) 11th Edition, Pearson
2	Digital Principles and Applications, D. Leach, A. Malvino and G Saha (2010) 7th Edition Tata Mc-Graw Hills Pub

3	Electronic Principles: A. Malvino and D. Bates (2006) 7th edition, Mc- Graw-Hill
4	The Art of Electronics: P. Horwitz and W. Hill (1989) 2nd edition, Cambridge University Press

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 212L	**Laboratory: Basic Electronics**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
Co-requisite:	PHY 212				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category		CORE	Basic Electronics		
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to train students about design and utilization as well understanding of several basic and advanced electronics devices using

		both analogue and digital electronics circuit elements.							
		LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
		At the end of the course, student will be able to							
1.		Use various electronic circuit elements and electronics ‘bread board’ to construct various electronics devices.							
2.		design and use and understand circuit characteristics of various analogue electronics devices like diodes, transistor, rectifier, CE & Operational amplifier.							
3.		design and verify various digital electronics logic gates (i.e. AND, NOT, OR, NOR etc.).							

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	To determine the forward and reverse characteristics of p-n junction To determine the Load line of junction diode	2	I,O		1,2
2.	To study the characteristics of a Zener Diode and to study its use as a Voltage Regulator	2	I,O		1,2
3.	To understand the theory of operation of the clipping and clamping diode circuits To design wave shapes that meet different circuit’s needs	2	I,O		1,2
4.	To study Half-wave Rectifier and investigate the effect of C, L and π filters To study Full-wave Bridge Rectifier and investigate the effect of C, L and π filters	4	I,O		1,2
5.	a) To study the various Transistor Biasing configurations a) To study the CE Characteristics of a Transistor and finding load line and Q-factor	4	I,O		1,2
6.	a) To design a CE Amplifier of a given gain (mid-gain) using Voltage Divider Bias b) To study Amplitude Modulation using Transistor.	4	I,O		1,2
7.	To study the working of op- amp as adder, sub tractor and comparator, To investigate the use of an op-amp as an Integrator and Differentiator. Design an analog circuit to simulate the solution of a first/second order differential equation.	4	I,O		1,2
8.	To design an Inverting and Non-Inverting Amplifier of given gain using Op-amp 741 and to study its Frequency Response.	2	I,O		1,2
9.	To design and study a precision Differential Amplifier of given I/O specification using Op-amp 741.	2	I,O		1,2

10.	To design an oscillator of given specifications using Op-amp 741	2	I,O		1,2
11.	To design a DC power supply with a given voltage and current output characteristic and define its load line	2	I,O		1,2
12.	Verify and design AND, OR, NOT and XOR gates truth tables with diode and Transistors.	2	I,O		1,2
13.	To verify and design AND, OR, NOT and XOR gates using NAND gate ICs	2	I,O		1,2
14.	To design a combinational logic system for a specified Truth Table	2	I,O		1,2
15.	To design an astable multivibrator of given specifications using IC-555 Timer	2	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	38			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Robert L. Boylestad and Louis Nashelsky "*Electronic Devices and Circuit Theory*" (2015) 11th Edition, Pearson
2	D. Leach, A. Malvino and G Saha "*Digital Principles and Applications*", (2010) 7th Edition Tata Mc-Graw Hills Pub
3	P. Horwitz and W. Hill "*The Art of Electronics*" (1989) 2nd edition, Cambridge University Press

Course nature		**Theory**			
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation Note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

PHY 213	**QUANTUM MECHANICS**		**L**	**T**	**P**	**C**
			3	1	**0**	4
Co-requisite:	NIL					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category		CORE	SLAB			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce the origin of quantum mechanics, Schrodinger's wave equations and their physical significances and applications

LEARNING OBJECTIVES		STUDENT OUTCOMES							
1.	Understand why "quantum mechanics"								
2.	Know the concept Schrodinger's wave equation								
3.	Solve different problems using Schrodinger's wave equation								
4.	Know various operators in quantum mechanics								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I - Black body Radiation	**9**			
1.	Detection of thermal radiation	1	C		1-5
2.	Emissive power of different bodies	1	C		1-5
3.	Absorptive power of different bodies	1	C		1-5
4.	Prevost's theory	1	C		1-5
5.	Black body radiation	1	C		1-5
6.	Kirchhoff's law	1	C		1-5
7.	Pressure of radiation	1	C		1-5
8.	Stefan-Boltzmann law and its experimental verification	1	C-D		1-5
9.	Nernst heat theorem	1	D		1-5
	UNIT II – Origin of Quantum Mechanics	**9**			
10.	Historical Background - Review of Black body radiation, Review of photoelectric effects	1	C		1-5
11.	Wave particle duality	1	C		1-5
12.	Matter waves, De Broglie hypothesis	1	C		1-5
13.	Davisson and Germer experiment	1	I		1-5
14.	Concept of wave packet	1	C		1-5
15.	Phase velocity, group velocity and relation between them	1	C		1-5
16.	Heisenberg's uncertainty principle with thought experiment	1	C		1-5
17.	Electron diffraction experiment	1	I		1-5

18.	Different forms of uncertainty	1	C		1-5
	UNIT III - The Schrodinger equation	**9**			
19.	Wave function and its physical interpretation	1	C		1-5
20.	Schrodinger time independent equation (Steady state equation)	1	C		1-5
21.	Properties of a wave function	1	C		1-5
22.	Probability current density	1	C		1-5
23.	Equation of continuity and its physical significance	1	C		1-5
24.	Definition of an operator in Quantum mechanics	1	C		1-5
25.	Eigen function and Eigen values	1	C-D		1-5
26.	Expectation value	1	C-D		1-5
27.	Ehrenfest's theorem	1	D		1-5
	UNIT IV: Applications of Schrodinger Steady state equation	**9**			
28.	Free particle, Particle in infinitely deep potential well (one – dimensional)	1	C		1-5
29.	Particle in a three dimensional rigid box	1	D		1-5
30.	Step potential, potential barrier (Qualitative discussion)	1	D		1-5
31.	Barrier penetration and tunneling effect	1	D		1-5
32.	Harmonic oscillator (one-dimension)	1	D		1-5
33.	Correspondence principle	1	C		1-5
34.	Hydrogen atom: Qualitative discussion on the radial and angular parts of the bound state energy	1	D		1-5
35.	Energy state functions	1	C		1-5
36.	Quantum numbers $\boldsymbol{n}$, $\boldsymbol{l}$, $\boldsymbol{m_l}$, $\boldsymbol{m_s}$ – Degeneracy	1	D-I		1-5
	UNIT V: Operators in Quantum Mechanics	**9**			
37.	Position, Momentum operator	1	C		1-5

38.	Angular momentum operator	1	C		1-5
39.	Total energy operator (Hamiltonian)	1	C		1-5
40.	Commutator brackets- Simultaneous Eigen functions	1	C		1-5
41.	Commutator algebra	1	C		1-5
42.	Commutator brackets using position	1	C		1-5
43.	Momentum and angular momentum operator	1	C		1-5
44.	Raising and lowering angular momentum operator	1	C		1-5
45.	Concept of parity, parity operator and its Eigen values	1	C		1-5
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, R. Eisberg and R. Resnik 2ed Edison, 2006, Wiley
2	Introduction to Quantum Mechanics, D. Griffiths 2 edition, 2004, Pearson
3	A Textbook of Quantum Mechanics K Venkatesan, P M Mathews 2nd Edition, 2010, Mcgraw Higher Ed.
4	Concepts of Modern physics, Arthur Besier, S. Rai Choudhury, Shobhit Mahajan, 7th Edition, 2015, Mcgraw Higher Ed
5	Quantum Mechanics: Theory and Applications, Ajoy Ghatak, S. Lokanathan, 1st Edition, 2004, Mc. Millan.

Course nature		**Theory**				
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
					End semester examination Weightage :	**50%**

Mathematics 2/Biology-2/Economics-2	Mathematics 2/Biology-2/ Economics-2
Chemistry 2 / Computer 2	Chemistry 2 / Computer 2

Allied Subjects: Chemistry-II

CHE112	**Principles of Chemistry-Ib**		**L**	**T**	**P**	**C**
			3	**0**	**2**	**4**
Co-requisite:	NIL					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category	P	PROFESSIONAL CORE	GENERAL CHEMISTRY			
Course designed by	Department of Chemistry					

Approval	-- Board of Studies Meeting -- , 2018

PURPOSE	The course provides an over view of general organic chemistry and will discuss the proprieties varies organic molecules carbohydrates, amino acids, peptides and proteins. The course will give detailed accounts of different kinds of spectroscopy techniques for analysis of organic molecules. Electronic spectra and Electroanalytical methods will be covered briefly. The fundamental concepts could be illustrated by the recent examples along with the contemporary knowledge

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Address the different properties of organic molecules							
2.	Know which are the carbohydrates, amino acids, peptides and proteins.							
3.	Develop a deep knowledge about the different kind spectroscopy techniques involved in the organic molecules characterization.							
4.	Learners should be able to provide physical explanation in key concepts of Electronic spectra and electroanalytical techniques.							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT-I: INTRODUCTION TO ORGANIC CHEMISTRY	**12**			
1.	Electronic structure and bonding	1	C	1-4	1,2
2.	Physical Effects: Boiling points, van der Waals forces, Dipole-Dipole Interactions	1	C	1	1,2
3.	Electronic Displacements: Inductive Effect, Electromeric Effect	2	C	1	1,2
4.	Cleavage of Bonds: Homolysis and Heterolysis	1	C,D	1	1,2
5.	Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles.	2	C	1	1,2
6.	Reactive Intermediates: Carbocations, Carbanions	1	C	1	1,2
7.	Free radicals and carbenes	1	C	1	1,2
8.	Strength of organic acids and bases: Definition of pKa, HSAB principle	2	C	1	1,2
9.	Aromaticity: Benzenoids and Hückel’s rule	1	C	1,3	1,2
	UNIT-II: CARBOHYDRATES, AMINO ACIDS, PEPTIDES AND PROTEINS	**9**			
10.	Classification of carbohydrates, reducing and non-reducing sugars.	1	C	2,3	1,2
11.	General Properties of Glucose and Fructose, their open chain structure	1	C	2,3	1,2
12.	Cyclic structure of fructose. Linkage between	1	C	1,2,3	1,2

	monosachharides, structure of disacharrides				
13.	Classification of Amino Acids, Strecker synthesis using Gabriel's phthalimide synthesis.	1	C	2,3	1,2
14.	Zwitterion structure and Isoelectric point.	1	C	1,2	1,2
15.	Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins	1	C	2	1,2
16.	Determination of primary structure of peptides	1	C	2	1,2
17.	Determination of N-terminal amino acid (by DNFB and Edman method)	1	C	2	1,2
18.	C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme).	1	C	2,3	1,2
	UNIT-III: INFRARED AND VIBRATIONAL SPECTROSCOPIES	**9**			
19.	Vibrational spectra, selection rules	1	C	3	1,2
20.	vibrational spectra of polyatomic molecules	1	C	3	1,2
21.	Normal modes and anharmonicity	1	C	3	1,2
22.	Interpretation of hydroxyl, carbonyl functional group	2	C	3	1,2
23.	Amino, and aromatic functional group	1	C	3	1,2
24.	Qualitative prediction of IR spectra	1	C	3	1,2
25.	Introduction to Raman spectroscopy	1	C	3	1,2
26.	Interpretation of infrared spectra of some organic and inorganic compounds.	1	C	3	1,2
	UNIT-IV: ELECTRONIC SPECTROSCOPY	**9**			3,4
27.	Transition moments, assignment of electronic transitions in organic molecular systems	1	C	2	3,4
28.	Fluorescence and phosphorescence	1	C	2	3,4
29.	Interpretation of absorption and emission spectra of small organic molecules and inorganic complexes.	2	C	3	3,4
30.	X-ray photoelectron spectroscopy	1	C	3	3,4
31.	Photoelectron spectroscopy	1	C	3	3,4
32.	Usefulness XPES and PES spectra	1	C	3	3,4
33.	Interpretation of spectra using organic and inorganic	2	C	3	3,4

	compounds				
	UNIT-V: ELECTROANALYTICAL METHODS	**6**			3,4
34.	Classification of electroanalytical methods	1	C	4	3,4
35.	Basic principle of pH metric	1	C	4	3,4
36.	Potentiometric and conductometric titrations	2			3,4
37.	Techniques used for the determination of equivalence points	1	C	4	3,4
38.	Techniques used for the determination of pKa values.	1	C	4	3,4
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	• Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.
2	• Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3	• William Kemp, Organic Spectroscopy, MacMillon.
4	• Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4 th Ed. Tata McGraw-Hill: New Delhi (2006).

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

Allied Subjects: Computer-II

Subject Code	Subject Name	Core/ Elective	L-T-P	Credits
CSEC	**Object Oriented Programming with Java**	**C**	**3-0-2**	**04**

SEMESTER-V

PHY 300R	Research Project 1	L	T	P	C
		0	0	4	2
Co-requisite:	NIL				
Prerequisite:	ALL PHYSICS CORE COURSES				
Data Book / Codes/Standards	NIL				
Course Category	CORE	**Dissertation**			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The project provides students with the opportunity to explore a particular problem of interest and address it through focused study and applied research under the direction of a faculty member. The Dissertation demonstrates the student's ability to synthesize and apply the knowledge and skills acquired in his/ her academic program to real problems. This Dissertation affirms students' ability to think critically and creatively, to solve practical problems, to make

	ethical and wise decisions, and to communicate effectively

LEARNING OBJECTIVES		STUDENT OUTCOMES							
At the end of the course, student will be able to									
1.	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.								
2.	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.								
3.	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.								
4.	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	The project is a major component of our Physics curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the last three years				
2.	Each student must register to the Dissertation course				
3.	Dissertation course consists of one semester and allow to be registered only during the final year of study.				
4.	Students enrolled in Dissertation course are grouped with a maximum of 3 students in one group.				
5.	Each Dissertation topic is assigned a faculty, who will act as the supervisor.				
6.	Each group must document and implement a management structure.				
7.	Each group is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session.				
8.	Salient points discussed at meetings with the supervisor (i.e.,suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work.				
9.	The contribution of each individual student in a				

	group will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done.				
10.	A project report is to be submitted on the topic which will be evaluated during the final review.				
11.	Assessment components will be as spelt out in the regulations.				
12.	The Dissertation report must possess substantial technical depth and require the students to exercise analytical, evaluation and design skills at the appropriate level,				

PHY 301	**Atomic and Molecular Physics**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Co-requisite:	PHY 303, PHY 301L					
Prerequisite:	PHY 213					
Data Book / Codes/Standards	NIL					
Course Category		CORE	Atomic and Molecular Physics			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce students about the atomic structure, Vector atom model, valence electron systems, different spectroscopy and laser to understand about atomic and molecular physics and its application.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**							
	At the end of the course, student will be able to								
1.	Understand about the atomic structure, Rutherford model, Bohr atom, Energy levels and spectra, and magnetic moments of atoms,								
2.	Learn the electron configuration, quantum states, spectral notations of quantum, States, spin orbit interaction, and Zeeman effect								

3.		Familiarize with various atomic models and atomic spectra								
4.		To prepare students with knowledge in LASER and its techniques								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I - Atomic structure	**9**			
1.	Rutherford model of atom	1	C		1,2
2.	Rutherford Model numerical	1	C		1,2
3.	Electron orbits	1	C		1,2
4.	Bohr atom	1	C-D		1,2
5.	Energy levels and spectra	1	C		1,2
6.	Numerical on energy level and spectra	1	I		1,2
7.	Sommerfield's elliptic orbits	1	C-D		1,2
8.	Numerical on Somerfield's theory	1	I		1,2
9.	Relativistic Corrections of Sommerfield's Theory	1	C		1,2
	UNIT II – Vector atom model	**9**			
10.	Vector atom model	1	C		1,2
11.	Concept of space	1	C		1,2
12.	Concept of quantization	1	C		1,2
13.	Electron spin	1	C		1,2
14.	Magnetic moments of atoms	1	C-D		1,2
15.	Numerical on quantization	1	I		1,2
16.	Stern-Gerlach experiment	1	O		1,2
17.	Atomic excitation and atomic spectra	1	C		1,2
18.	Numericals on atomic excitation and atomic spectra	1	I		1,2
	UNIT III - One and two valence electron systems	**9**			
19.	Pauli Exclusion Principle	1	C		2,3
20.	Electron configuration	1	C		2,3
21.	Quantum states, Electron spin	1	C		2,3
22.	Spin-Orbit Interaction, Energy levels of Na atom	1	C		2,3
23.	Sodium Doublet, Spectral terms of two electron atoms	1	C		2,3
24.	Terms for equivalent electrons, L-S and J-J coupling schemes	1	C		2,3
25.	Singlet-Triplet separation for interaction energy of L-S coupling	1	C		2,3
26.	Landé g-factor Landé Interval rule	1	C		2,3
27.	Spectra of Helium atom, Zeeman Effect	1	C		2,3
	UNIT IV: Atomic and Molecular spectroscopy	**9**			

28.	EM spectrum, X-ray	1	C		3,4,5
29.	Daune and Hunt's Rule	1	C		3,4,5
30.	X-ray emission spectra	1	C		3,4,5
31.	Bremsstrahlung effect	1	C		3,4,5
32.	Mosley's law and its applications	1	C-I		3,4,5
33.	Auger effect, Electronic spectra of molecules	1	C		3,4,5
34.	Rotational spectra of diatomic molecules	1	C		3,4,5
35.	Raman Effect	1	C		3,4,5
36.	Molecular Polarizability	1	C		3,4,5
	UNIT V: Lasers	**9**			
37.	Optical absorption and emission	1	C		3,4,5
38.	Einstein coefficients	1	C		3,4,5
39.	Optical pumping	1	C-D		3,4,5
40.	Masers principles	1	C-D		3,4,5
41.	Lasers principles	1	C-D		3,4,5
42.	Numerical of Lasers	1	I		3,4,5
43.	Ruby Laser principles	1	C		3,4,5
44.	He-Ne Laser Principles	1	C		3,4,5
45.	Solid state and semiconductor lasers	1	C-D		3,4,5
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS
1	Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, R. Eisberg and R. Resnik 2nd Edison, 2006, Wiley
2	Concepts of Modern physics, Arthur Besier, S. Rai Choudhury, Shobhit Mahajan, 7th Edition, 2015, Mcgraw Higher Ed
3	Atomic Physics, J. M. Rajam, Revised Edition, 2010, S Chand Publication
	REFERENCE BOOKS/OTHER READING MATERIAL
4	The Fundamentals of Atomic and Molecular Physics, Brooks, Robert L. 1 Edition, 2013, Springer-Verlag New York
5	Physics of Atoms and Molecules, B. H. Bransden, C. J. Joachain, 2 Edition, Pearson Education India

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	Assignment	Class Test and Quiz	**Total**

	Weightage	15%	15%	10%	10%	50%
End semester examination Weightage :						50%

PHY 302	Electrodynamics	L	T	P	C
		3	0	0	3
Co-requisite:	PHY 303, PHY 302L				
Prerequisite:	PHY 115				
Data Book / Codes/Standards	NIL				
Course Category	CORE	**Electrodynamics**			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to introduce students about the electromagnetic wave, magnetic properties and electrodynamics.

LEARNING OBJECTIVES	**STUDENT OUTCOMES**					
At the end of the course, student will be able to						
1. To understand the general concepts in Magnetostatics						
2. To learn the fundamentals of electromagnetic wave theory						
3. To develop problem solving skills in Electromagnetism						
4. To explore the field of electricity and magnetism						

Session	Description of Topic	Contact	C-	IOs	Referenc

		hours	D-I-O		e
	UNIT I - Magnetostatics	**9**			
1.	Concept of magnetic field intensity (B) and flux, Definition and properties of magnetic field	1	C		1,2
2.	Definition of B and H, Calculation of divergence and curl of B with boundary conditions	1	C		1,2
3.	Lorentz Force law, motion of charged particles in electric and magnetic field, Cyclotron frequency	1	C		1,2
4.	Biot – Savart's law, Illustration with long straight conductor, current carrying circular loop on the axis	1	C-D		1,2
5.	Calculation of field on the Axis and in plane of a circular current-carrying Coil, Helmholtz Coils	1	C-D		1,2
6.	Magnetic moment of a current carrying loop	1	D		1,2
7.	The Permeability of Free Space, Ampère's Law – worked examples	1	D-I		1,2
8.	Force Between Two Current-carrying Wires	1	C		1,2
9.	Problems based on magnetic field and Magnetostatics	1	I		1,2
	UNIT II – Magnetism and Magnetic properties	**9**			
10.	Magnetic Materials - An Overview	1	C		1,2
11.	Magnetic moment, Bohr magneton	1	C		1,2
12.	Magnetisation (M), Magnetic Intensity (H) and magnetic induction (B) – their mathematical relations	1	C		1,2
13.	Magnetisation and Susceptibility and magnetic permeability of magnetic materials	1	C		1,2
14.	Magnetic field of magnetized objects and bound currents	1	C		1,2
15.	Magnetic field due to a uniformly magnetized sphere	1	C		1,2
16.	Diamagnetic, paramagnetic and ferromagnetic	1	C		1,2
17.	Explanation of Diamagnetic, paramagnetic and ferromagnetic with the help of susceptibility and permeability Hysteresis and B-H Loops	1	C		1,2
18.	Problems on magnetism and its properties	1	I		1,2
	UNIT III - Electromagnetic Induction	**9**			
19.	Time varying fields: Faradays law of induction, worked examples	1	C-I		1,2

20.	Mutual inductance, coupled circuits and coefficient of coupling	1	C-D		1,2
21.	Leakage inductance, impedance matching	1	C-D		1,2
22.	Transformer circuit	1	C		1,2
23.	Reflected impedance transformation, equivalent circuit of a transformer	1	C		1,2
24.	Lenz's Law, Worked examples	1	C-D		1,2
25.	Ballistic Galvanometer and the Measurement of Magnetic Field	1	C		1,2
26.	AC Generator, AC Power,0 Linear Motors Generators, Rotary Motors	1	C-D		1,2
27.	Generators, Rotary Motors	1	C		1,2
	UNIT IV: Electrodynamics	**9**			
28.	Generalization of Amperes' law	1	C		3,4,5
29.	Problems on Amperes' law – worked examples	1	I		3,4,5
30.	Maxwell's equation	1	C		3,4,5
31.	Maxwell's equation - Differential form	1	C		3,4,5
32.	Maxwell's equation -Integral form	1	C		3,4,5
33.	Problems on Maxwell's equation	1	I		3,4,5
34.	Magnetic Vector potentials	1	C		3,4,5
35.	Retarded potential	1	C		3,4,5
36.	Problems on Magnetic potentials	1	I		3,4,5
	UNIT V: Electromagnetic waves	**9**			
37.	Wave equation and plane waves in free space	1	C		3,4,5
38.	Poynting theorem	1	C		3,4,5
39.	Polarizations of plane wave	1	C		3,4,5
40.	Plane monochromatic waves in conducting media	1	C-I		3,4,5
41.	Reflection from a conducting plane	1	C-I		3,4,5

42.	Skin effect ,Absorption and scattering	1	C-I		3,4,5
43.	Absorption and scattering of electromagnetic waves	1	C		3,4,5
44.	Anomalous dispersion	1	C-I		3,4,5
45.	Problems on electromagnetic waves – worked examples	1	C-I		3,4,5
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS
1	University Physics with Modern Physics, Hugh D. Young, Roger A. Freedman, A Lewis Ford, 13 Edition, 2013, Pearson India
2	Electricity and Magnetism (In Si Units): Berkeley Physics Course - Vol.2 Edward Purcell 2017, McGraw Hill Education
3	Introduction to Electrodynamics, David J. Griffiths, 4/e Edition, 2015, Pearson Publication
	REFERENCE BOOKS/OTHER READING MATERIAL
4	Classical Electrodynamics, John David Jackson, 3 Edition 2007, Wiley
5	Physics, Volume 2 David Halliday, Robert Resnick, Kenneth S. Krane, 5 Edition, 2001, John Wiley & Sons

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
					End semester examination Weightage :	**50%**

PHY 303	Solid State Physics	L	T	P	C
		3	0	0	3
Co-requisite:	PHY 301, PHY 302, PHY 303L				
Prerequisite:	PHY 213				
Data Book / Codes/Standards	NIL				
Course Category	CORE	Solid State Physics			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to introduce students about the crystal structure and crystal system, free electron theory of metsl, band theory, electrical and thermal conductivity.

LEARNING OBJECTIVES	STUDENT OUTCOMES						
At the end of the course, student will be able to							
1. To understand the basic knowledge on crystal structures and crystal systems							
2. To acquire the knowledge of bonding in solids							
3. To acquire knowledge on lattice vibrations, thermal properties and electric conductivity of solids							
4. To comprehend the concepts of dielectric properties of solids and superconductivity							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference

	UNIT I - Crystallography	**9**			
1.	Crystalline and amorphous solids, Lattice, Basis, Translational vectors, Primitive unit cell.	1	C		1,2
2.	Symmetry operations, Different types of lattices-2D and 3D (Bravais lattices)	1	C		1,2
3.	Miller indices, Inter-planer distances, SC, BCC and FCC structures, Packing fraction	1	C		1,2
4.	Crystal structures- NaCl, diamond, CsCl, ZnS,	1	C		1,2
5.	Concept of reciprocal lattice and its properties with proof. Ionic, covalent, molecular and metallic binding in crystalline solids	1	C		1,2
6.	Cohesive energies of ionic and metallic crystals.	1	C		1,2
7.	Anisotropy of physical properties of a single crystal, defects in crystal structures Crystal as a grating	1	C		1,2
8.	Bragg's law and Bragg's Diffraction condition in direct and reciprocal lattice Ewald's construction	1	C,D		1,2
9.	Debye Schrrerer method	1	D-I		1,2
	UNIT II – Lattice Vibrations and specific heat of solids	**9**			
10.	Specific heats of solids	1	C		1,2
11.	Normal mode of frequencies coupled vibrations of atoms	1	C		1,2
12.	Breakdown of classical theory	1	C-D		1,2
13.	Linear chain frequency distribution function	1	C-D		1,2
14.	Quantization of harmonic vibrations	1	C-D		1,2
15.	Phonons	1	C		1,2
16.	Debye theories of specific heat of solids	1	C-D		1,2
17.	Einstein theories of specific heats of solids	1	D-I		1,2
18.	Phonon vibration of diatomic linear lattice	1	D-I		1,2
	UNIT III - Free electron theory of metals	**9**			
19.	Free Electron model	1	C		3,4
20.	Energy levels and Density of orbital in 1D and 3D	1	C-D		3,4
21.	Bloch function	1	C-D		3,4
22.	Nearly free electron model (NFE model)	1	C		3,4
23.	Fermi energy, Application of the Fermi-Dirac	1	C-D		3,4

	distribution				
24.	Specific heat due to conduction electron	1	C-D		3,4
25.	Para-magnetism, thermionic emission,	1	C		3,4
26.	Photoelectric effect of metals,	1	C		3,4
27.	Origin of contact potentials between metals	1	C		3,4
	UNIT IV: Band theory of solids, electrical and thermal conductivity	**9**			
28.	Band theory of solids	1	C-D		5,6
29.	Band formation	1	C		5,6
30.	Fermi-sphere, example of simple cubic lattice	1	C		5,6
31.	Idea of Brillouin zone	1	D-I		5,6
32.	Density of states	1	D-I		5,6
33.	overlapping on energy bands	1	D		5,6
34.	Effective mass of electron (with derivation)	1	C-D		5,6
35.	Concept of hole	1	C-D		5,6
36.	Distinction between metal, semiconductor and insulator	1	C		5,6
	UNIT V: Electrical and thermal conductivity in solids	**9**			
37.	Simple theories of electrical and thermal conductivity	1	C		5,6
38.	The Wiedemann-Franz law	1	C-D		5,6
39.	Boltzmann transport equation	1	C-D		5,6
40.	Sommerfeld theory of electrical conductivity	1	C		5,6
41.	Mean free path of electrons	1	C-D		5,6
42.	Temperature dependent resistivity of metals	1	D-I		5,6
43.	Temperature dependent resistivity of semiconductors, and insulators	1	D-I		5,6
44.	Hall Effect in metals	1	I		5,6
45.	Hall Effect in semiconductors	1	I		5,6

	Total contact hours	45

LEARNING RESOURCES	
	TEXT BOOKS
1	Elementary Solid-State Physics, M Ali Omar, Revised Edition, 2015, Pearson
2	Introduction to Solid State Physics, Charles Kittel, 8th edition, 2004, John Wiley & Sons
3	Solid State Physics Puri R.K., Babbar V.K – 1 Edition, 2010 S Chand Publication
4	Solid State Physics, S O Pillai, 18th edition 2018, New Age International
	REFERENCE BOOKS
5	Solid State Physics, Neil W. Ashcroft, N. Mermin Reprint Edition, Brooks/Cole 1976
6	Solid State Physics, A. J. Dekker, 2008, Laxmi Publication/Prentice Hall

Course nature						**Theory**
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid term I	Mid term II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
					End semester examination Weightage :	**50%**

PHY304	**Advanced Optics**			L	T	P	C
				3	**0**	**0**	**3**
Co-requisite:	PHY 301, PHY 304L						
Prerequisite:	PHY 213, PHY 201						
Data Book / Codes/Standards	NIL						
Course Category		CORE	Atomic and Molecular Physics				
Course designed by	Department of Physics						
Approval	-- Academic Council Meeting -- , 2018						

PURPOSE	The purpose of this course is to introduce students about the physical optics, interference and diffraction of light, polarization and fiber optics.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the concept of basic optics							
2.	Understand the concept of Interference							
3.	Study the fundamentals of diffraction							
4.	Apply the concept of optics in holography and fiber optics							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**

	UNIT I - Physical Optics	**9**			
1.	History of optics	1	C		1,2
2.	what is light?	1	C		1,2
3.	Huygen's principle	1	C		1,2
4.	Huygen's principle applications,	1	C		1,2
5.	Derivation of the laws of reflection	1	D,I		1,2
6.	Derivation of the laws of refraction	1	D,I		1,2
7.	Superposition of waves	1	C,D		1,2
8.	Coherence	1	C		1,2
9.	Problems	1	I		1,2
	UNIT II – Interference of light	**9**			1,2
10.	Two beam interference by division of wave front	1	C		2,3
11.	Interference by division of amplitude	1	C		2,3
12.	Classification of interference of thin films	1	C,D		2,3
13.	Interference by wedge shaped film: Interference due to reflected light and transmitted light	1	C		2,3
14.	Fringes of equal inclination	1	C		2,3
15.	Equal thickness and Equal chromatic order (FECO fringes)	1	C		2,3
16.	Colours of thin films	1	C		3,4
17.	Michelson's interferometer	1	I		3,4
18.	Fabry-Perot interferometer	1	I		3,4
	UNIT III - Diffraction of Light	**9**			3,4
19.	Fraunhoffer diffraction due to a (i) single slit, and	1	C,D		3,4
20.	(ii) double slit, N silts	1	I		3,4
21.	(iii) plane transmission grating and their analytical treatments	1	I		3,4
22.	Plane diffraction grating	1	C,I		3,4
23.	Rayleigh's criteria for resolution	1	C		3,4

24.	Resolving power of a grating	1	C		3,4
25.	Fraunhoffer’s diffraction	1	C		3,4
26.	Fresenel’s diffraction	1	C		3,4
27.	Problems	1	I		3,4
	UNIT IV: Polarization of light	**9**			3,4
28.	Introduction to polarization	1	C		3,4
29.	Types of polarization- plane, circular, elliptical	1	C,I		3,4
30.	Polarization by reflection of light,	1	C		3,4
31.	Brewster’s law,	1	C		3,4
32.	Law of Malus	1	C		3,4
33.	Polarisation by double refracting uniaxial crystals,	1	C		3,4
34.	Ordinary and extraordinary light	1	C		4,5
35.	Linear polarizer (Polaroid)	1	C		4,5
36.	Fabrication of linear polarizer by Nicol prism	1	D,I		4,5
	UNIT V: Fiber optics and Holography	**9**			4,5
37.	Optical fiber basics using ray optics	1	C		4,5
38.	Basic waveguide theory	1	C		4,5
39.	Concept of modes	1	C		4,5
40.	Single-mode	1	C		4,5
41.	Multimode fiber	1	C		4,5
42.	Optical fiber communication (discussion only)	1	C		4,5
43.	Introduction to holography techniques	1	C		4,5

44.	Applications of Holography	1	I		4,5
45.	Problems	1	I		4,5
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Optics, Eugune Hecht, A. R. Ganesan, 4 Edition, 2008, Pearson Education
2	Introduction to Optics, Frank L Pedrotti, 1 Edition, 2014, Pearson Education
3	Optics, Ajoy Ghatak, 5 Edition, 2012, McGraw Hill Education
4	Geometrical and Physical Optics, R.S. Longhurst, 3rd Revised edition, 19974, Longman
5	Optics, Miles V. Klein, Thomas Elton Furtak, Wiley series in pure and applied optics, 1986, Wiley

Course nature			**Theory**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid-term I	Mid-term II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 301L	**Laboratory: Atomic and Molecular Physics**		**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**
Co-requisite:	PHY 301					
Prerequisite:	PHY 203, PHY 211					
Data Book / Codes/Standards	NIL					
Course Category		CORE	Atomic and Molecular Physics			

Course designed by	Department of Physics
Approval	-- Academic Council Meeting -- , 2018

PURPOSE	The purpose of this course is to introduce students about how the fundamental atomic, molecular physics and basic Laser characteristics aid in the advanced technology through properly designed experiments.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	Correlate Atomic and Molecular physics theories with real life examples							
2.	Realize the profound importance of atomic and molecular spectroscopy in the basic and inter disciplinary science.							
3.	Handle up to class 3 Lasers and realize the importance of safety, scientific and industrial applications of various Lasers.							

Sl. No.	**Description of experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	To record the Franck-Hertz characteristic curve for neon emission	4	I,O		1,2
2.	a) To determine the wavelengths of Balmer series in the visible region from atomic emission b) To determine the Rydberg constant	4	I,O		1,2
3.	To determine Planck's Constant by Cs Photocell	4	I,O		1,2
4.	To observe the Zeeman splitting of the green (546.1nm) mercury line using Fabry-Perot etalon for normal transverse and longitudinal configuration.	4	I,O		1,2
5.	Measuring the speed of sound, by measuring the Bragg angle using an acousto-optics modulator and laser diffraction.	6	I,O		1,2
6.	To determine beam divergence and M-parameter of a He-Ne laser beam and compare it with commercial laser pointer beam.	6	I,O		1,2
7.	To determine beam divergence and M-parameter of a commercial laser pointer beam	4	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	32			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	http://www.atomic.physics.lu.se/education/mandatory-courses/fystc11-atomic-and-molecular-physics-for-science-faculty/laboratory-exercises/

Course nature				**Theory**	
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

PHY 302L	**Laboratory: Electrodynamics**		**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**
Co-requisite:	PHY 302					
Prerequisite:	PHY 115, PHY115L, PHY 213					
Data Book / Codes/Standards	NIL					
Course Category	CORE	Electrodynamics				
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce students about how the fundamental properties of magnetic materials and its importance in the everyday life technological applications. Correlate the impact of fundamental electromagnetic principles to the advanced technology.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	Realize the importance of fundamental Maxwell electromagnetic equations and be able to develop numerous applications using electronic and magnetic properties of matter.							
2.	Realize the necessity of time varying electric, magnetic fields in energy and power sectors.							
3.	Handle high current and voltage power supplies.							

Sl. No.	**Description of experiments**	**Contact hours**	**C-D-I-**	**IOs**	**Reference**

			O		
1.	To study the magnetic field along the axis of a current carrying circular loop and study the dependency of magnetic field on the diameter of coil	6	I,O		1,2
2.	To calculate the magnetic flux induced by the falling magnet as a function of the velocity of the magnet and measure induced voltage impulse as a function of the velocity of the magnet	6	I,O		1,2
3.	To investigate the spatial distribution of magnetic field between coils and determine the spacing for uniform magnetic field	6	I,O		1,2
4.	To demonstrate Dia-Para-Ferro magnetism in a given material using an inhomogeneous magnetic field	6	I,O		1,2
5.	To study permeability curve of a given material.	6	I,O		1,2
6.	To determine susceptibility of paramagnetic sample by using Quinck's tube method.	6	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	36			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	K.G. Mazumdar and B. Ghosh, "*Advanced Practical Physics*" Sreedhar Publishers, Revised edition Jan 2004
2	R.K. Shukla and Anchal Srivastava, "*Practical Physics*" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]
3	Michael Coey, "Magnetism and Magnetic Materials" Cambridge University Press, 2010 [ISBN: 9780511845000]

Course nature			**Theory**		
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

PHY 303L	Laboratory: Solid State Physics	L	T	P	C
		0	0	4	2
Co-requisite:	PHY 301, PHY 302				
Prerequisite:	PHY 213,				
Data Book / Codes/Standards	NIL				
Course Category	CORE	Solid state physics			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose is to introduce the sophisticated and best experimental characterization tools to obtain the basic attributes of solids, such as, crystallinity, optical, electronic, magnetic, plasmonic, nano form of matter. Introduce to the current state-of-the art research facilities to carry research projects. Demonstrate the power of century old basic fundamental laws existence in the present technology.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	Measure the lattice parameter, lattice crystal structure, electronic properties, bandgap, plasmonic, carrier densities of any kind of state of matter. Which are all the fundamental and basic attributed of any matter.							
2.	Develop new characterization tools and techniques for advanced materials.							
3.	Can handle state-of-the-art instruments and appreciate the importance of research and development in the everyday life.							

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Measurement of resistivity of a semiconductor by Four-probe method and determination of Energy Band Gap	6	I,O		1,2
2.	To determine the type of charge carrier, carrier density and Hall coefficient of a given semiconductor	6	I,O		1,2
3.	a) To measure the photo-current as a function of the	6	I,O		1,2

	irradiance at constant voltage b) Current-voltage and current-load characteristics of a solar cell as a function of the irradiance				
4.	Study optical absorption of liquid samples using UV-VIS spectrometer	6	I,O		1,2
5.	To study optical absorption of different nanoparticles and obtain their plasmonic peaks	6	I,O		1,2
6.	Determine lattice parameter of crystals using X-ray diffractometer	6	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	36			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	C. Suryanarayana, M. Grant Norton, ” X-Ray Diffraction, A Practical Approach” Springer US, 1998 [ISBN: 978-1-4899-0148-4]
2	Trügler, Andreas, “Optical Properties of Metallic Nanoparticles”, Springer Series in Materials Science, 2016 [ISBN: 978-3-319-25074-8]
3	John Singleton, “Band Theory and Electronic Properties of Solids” Oxford University Press UK, 2014 [ISBN: 978-0198506447]

Course nature			**Theory**		
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

PHY 304L	**Laboratory: Advanced Optics**		**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**
Co-requisite:	PHY 304					
Prerequisite:	PHY 201, PHY 201L, PHY 213					
Data Book / Codes/Standards	NIL					
Course Category		CORE	Advanced Optics			
Course designed by	Department of Physics					
Approval	-- Academic Council Meeting -- , 2018					

PURPOSE	The purpose of this course is to introduce the student into a realm world of optics where each and every principle of optics end up in using various spectrometries and also in real time optoelectronic technologies. Train and promote students to develop new optical techniques and applications for next generation scientific and technological challenges.

	LEARNING OBJECTIVES	STUDENT OUTCOMES						
	At the end of the course, student will be able to							
1.	Measure the wavelength, refractive index, TE and TM losses of optical fibers.							
2.	Develop new techniques to detect light, polarization of light.							
3.	Can handle optical fibers.							

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	a) Determination of phase difference and wavelength using Michelson's interferometer b) Determination of Refractive index of glass plate using Michelson's interferometer	4	I,O		1,2
2.	To observe the diffraction patterns by holes/single slit double slit with He-Ne laser source	4	I,O		1,2
3.	To observe the diffraction patterns by grating and obtain resolving power of the grating	4	I,O		1,2
4.	To measure the light intensity of plane polarized light as a function of the analyzer position and verify Malus law (inverse square law)	4	I,O		1,2
5.	Experimental verification of Fresnel's equations for reflection of electromagnetic waves	4	I,O		1,2
6.	To determine the specific rotation of cane sugar solution using Polarimeter	4	I,O		1,2
7.	To measure the light intensity as a function of voltage across the Kerr cell using photo detector	4	I,O		1,2
8.	a) Calculate the numerical aperture and study the losses that occur in optical fiber cable b) To study losses at FIBER junctions c) To measure losses in dB of two optical FIBER patchcords and the coefficient of attenuation	4	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	32			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Grant R. Fowles, " Introduction to modern optics" Dover Publications, Inc., New York, 1968 [ISBN: 978-0-4861-3492-5]
2	Ajoy Ghatak, K. Thyagarajan, "An Introduction to Fiber Optics", Cambridge University Press, 1998 [ISBN: 9781139174770]

Course nature					Theory
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

SEMESTER-VI

PHY 310R	**Research Project 2**			**L**	**T**	**P**	**C**
				0	**0**	**8**	**4**
Co-requisite:	NIL						
Prerequisite:	PHY 300R, ALL CORE PHYSICS COURSES						
Data Book / Codes/Standards	NIL						
Course Category		CORE	**Dissertation**				
Course designed by	Department of Physics						
Approval	-- Academic Council Meeting -- , 2018						

PURPOSE	The project provides students with the opportunity to explore a particular problem of interest and address it through focused study and applied research under the direction of a faculty member. The Dissertation demonstrates the student's ability to synthesize and apply the knowledge and skills acquired in his/ her academic program to real problems. This Dissertation affirms students' ability to think critically and creatively, to solve practical problems, to make ethical and wise decisions, and to communicate effectively

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.							
2.	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.							
3.	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.							
4.	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
13.	The project is a major component of our Physics curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the last three years				
14.	Each student must register to the Dissertation course				
15.	Dissertation course consists of one semester and allow to be registered only during the final year of study.				
16.	Students enrolled in Dissertation course are grouped with a maximum of 3 students in one group.				
17.	Each Dissertation topic is assigned a faculty, who will act as the supervisor.				
18.	Each group must document and implement a management structure.				
19.	Each group is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session.				
20.	Salient points discussed at meetings with the supervisor (i.e.,suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work.				
21.	The contribution of each individual student in a group will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done.				
22.	A project report is to be submitted on the topic which will be evaluated during the final review.				
23.	Assessment components will be as spelt out in the regulations.				
24.	The Dissertation report must possess substantial technical depth and require the students to exercise analytical, evaluation and design skills at the appropriate level,				

PHY 311	Statistical Physics	L	T	P	C
		3	1	0	4

Co-requisite:	NIL		
Prerequisite:	PHY 202, PHY 213		
Data Book / Codes/Standards	NIL		
Course Category		CORE	Statistical Physics
Course designed by	Department of Physics		
Approval	-- Academic Council Meeting -- , 2018		

PURPOSE	The purpose of this course is to introduce students about elementary as well advanced concepts of statistical physics using elements of classical and quantum statistics.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand Elementary statistical concepts							
2.	Learn statistical descriptions of system of particles							
3.	Learn Statistical properties of Macroscopic systems							
4.	Learn micro-canonical, canonical and grand-canonical systems and Equipartition theorem							
5.	Fundamental concepts of Quantum Statistics							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I - Elementary statistical concepts and examples	**9**			
1.	The simple random walk problem in one dimension	1	C		1,2
2.	Random walk problem in two dimensions	1	C		1,2
3.	Problem and Review of Random walks	1	C		1,2
4.	Examples of Brownian motion	1	C		1,2
5.	Calculation of mean values	1	C		1,2
6.	Binomial distribution – theory and examples	1	C		1,2
7.	Continuous probability distribution	1	C		1,2
8.	Gaussian probability distribution	1	C		1,2
9.	Review and problems on probability distributions	1	C		1,2
	UNIT II – Statistical descriptions of system of	**9**			

	particles				
10.	Specification of the state of a statistical system	1	C		1,2
11.	statistical ensemble - basic postulates and probability calculations	1	C		1,2
12.	Review and problems on statistical ensembles	1	C		1,2
13.	Density of states of statistical ensembles	1	C		1,2
14.	Problems on density of states	1	I		1,2
15.	Thermal and mechanical interaction between macroscopic systems.	1	C		1,2
16.	Discussion on constraints of thermal and mechanical interaction between macroscopic systems.	1	C,D		1,2
17.	Discussion on equilibrium, non-equilibrium, reversibility and irreversibility in thermodynamic systems	1	C,D		1,2
18.	Review and problems on thermal and mechanical interaction, its constraints and Problems & examples on Equilibrium/non-equilibrium and reversibility /irreversibility of thermodynamic systems.	1	C,D		1,2
	UNIT III - Statistics of Macroscopic systems	**9**			
19.	Distribution of energy between macroscopic systems	1	C		1,2
20.	Discussion on the approach to thermal equilibrium	1	C		1,2
21.	Examples and problems on thermal equilibrium	1	C		1,2
22.	Temperature, mean energy and mean pressure of an ideal gas	1	C		1,2
23.	Introduction of the concept of entropy & discussion of second and third law of thermodynamics involving entropy.	1	C		1,2
24.	Review of all thermodynamic laws and basic statistical relations & related problems	1	C		1,2
25.	The partition function and its properties – relevant problems	1	C		1,2
26.	Calculation of thermodynamic quantities for an ideal monatomic gas – relevant problems.	1	D,I		1,2
27.	Discussion of the Gibbs paradox involving relevant examples	1	C		1,2
	UNIT IV: Equipartition theorem	**9**			
28.	Introduction various thermodynamics systems – Isolated, adiabatic, Isobaric, Isochoric etc.	1	C		1,2

29.	Examples and problems on important thermodynamic systems.	1	I		1,2
30.	Discussion on Canonical ensemble – comparison with micro-canonical ensemble	1	C		1,2
31.	Applications, examples and problems on the canonical ensemble	1	I		1,2
32.	Maxwell distribution and the Equipartition theorem	1	C		1,2
33.	Simple applications of the Equipartition theorem	1	I		1,2
34.	The grand canonical ensemble – comparison with micro-canonical and canonical ensemble	1	C		1,2
35.	Introduction of the chemical potential	1	C		1,2
36.	Review and problems on Equipartition theorem and canonical and grand-canonical ensemble	1	D,I		1,2
	UNIT V: Quantum statistics	**9**			
37.	Introduction of concept of Identical particles and symmetry requirements	1	C		1,2
38.	Discussion on quantum states of a single particle	1	C		1,2
39.	Introduction of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics	1	C		1,2
40.	Equation of states for Bose and Fermi gases	1	C		1,2
41.	PV = (2/3) E – the ideal gas in the classical limit	1	C		1,2
42.	Evaluation of the partition function	1	I		1,2
43.	partition function of ideal monatomic Boltzmann gas	1	I		1,2
44.	Simple ideas for Bose- Einstein condensation and recent observations	1	C		1,2
45.	Problems and examples on Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics & partition function	1	D,I		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Statistical Physics (In Si Units): Berkeley Physics Course - Vol.5, F Reif, 1 edition, 2017, McGraw Hill Education
2	Statistical Physics F. Mandl, 2nd Edition, 2003, Wiley

Course nature	**Theory**
Assessment Method (Weightage 100%)	

In-semester	Assessment tool	Cycle test I	Cycle test II	Assignment	Class Test	Total
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
					End semester examination Weightage :	**50%**

PHY 312	**NUCLEAR AND PARTICLE PHYSICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	PHY 312L				
Prerequisite:	PHY 213				
Data Book / Codes/Standards	NIL				
Course Category	CORE	**Nuclear and Particle Physics**			
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to introduce students about the nuclear and particle physics, radioactivity, nuclear reactors and particle detectors.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	To address the basic properties of nucleus and associated models							
2.	To provide detailed knowledge of radioactivity							
3.	To discuss the elementary particles.							
4.	To familiarize the learners to the nuclear reactors, particle detectors and accelerators							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT I - Basic Properties of Nucleus	**9**			
1.	Composition, charge, size, density of nucleus	1	C		1,2
2.	Nuclear Models, Shell Model: Assumptions, Evidences,	1	C		1,2
3.	Spin and Parity limitations	1	C		1,2
4.	Liquid drop model: Assumptions, semi-empirical mass formula, limitations	1	C		1,2
5.	Mass defect and Binding energy, packing fraction	1	C		1,2
6.	Classification of nuclei, stability of nuclei (N Vs Z Curve)	1	C		1,2

7.	Nuclear Angular momentum, nuclear magnetic dipole moment	1	C		1,2
8.	Electric quadrupole moment	1	C		1,2
9.	Parity and symmetry	1	C		1,2
	UNIT II – Radioactivity	**9**			
10.	Radioactivity disintegration, natural and artificial radioactivity	1	C		1,2
11.	Alpha decay, measurement of velocity and energy of alpha particles, Geiger-Nuttal law	1	C		1,2
12.	Alpha particle spectra, nuclear energy levels, qualitative theory of alpha decay	1	C		1,2
13.	Beta decay: velocity and energy of beta particles, beta spectra,	1	C		1,2
14.	internal conversion, position emission and orbital electron capture, the neutrino	1	C		1,2
15.	Gamma rays: measurement of gamma energies, absorption by matter and pair production,	1	C,I		1,2
16.	nuclear levels and gamma spectra, internal conversion.	1	D,I		1,2
17.	Discovery of the neutron, mass and life time of the neutron	1	C		1,2
18.	Application of radioactivity (Agricultural, Medical, Industrial, Archaeological)	1	D,I		1,2
	UNIT III - Nuclear forces and Elementary particles	**9**			
19.	Meson theory of nuclear forces,	2	C		1,2
20.	Properties of nuclear forces	2	C		1,2
21.	Properties of deuteron system	1	C		1,2
22.	Elementary particles	2	C		1,2
23.	Quarks model for elementary particles	2	C		1,2
	UNIT IV - Nuclear Reactions and Energy	**9**			
24.	Introduction to Nuclear reactions	1	C		1,2
25.	compound nuclear Q-value equation	1	C		1,2

26.	Exothermic and Endothermic, reaction Threshold energy	1	C		1,2
27.	Conservation laws, nuclear cross-section.	1	C		1,2
28.	Nuclear fission, chain reaction and critical mass	1	C		1,2
29.	Nuclear reactor and its basic components	1	C		1,2
30.	Homogeneous and heterogeneous reactors .	1	C		1,2
31.	Power reactor, fast breeders	1	C		1,2
32.	Nuclear fusion, stellar energy	1	C		1,2
	UNIT V - Particle Detectors and Accelerator	**9**			
33.	Gas filled Detectors (G. M. counter)	2	C,D		1,2
34.	Solid-state detectors (scintillation counter)	2	C,D		1,2
35.	Classification of Nuclear Detector	1	D,I		1,2
36.	Introduction to particle Accelerators - Linear (electron/proton Linear accelerators)	2	C,D		1,2
37.	Cyclic (Cyclotron) particle Accelerators	2	C,D		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	The Atomic Nucleus, R. D. Evans, Reprint Edition, 1995 Tata McGraw Hill co.
2	Nuclear Physics, I Kaplan Reprint 4th Edition, 2002 Narosa Publishing House

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**50%**

PHY 312L	**Laboratory: Nuclear and Particle Physics**	**L**	**T**	**P**	**C**

		0	0	4	2
Co-requisite:	PHY 312				
Prerequisite:	PHY 213, PHY 303L,				
Data Book / Codes/Standards	NIL				
Course Category		CORE	Nuclear and Particle Physics		
Course designed by	Department of Physics				
Approval	-- Academic Council Meeting -- , 2018				

PURPOSE	The purpose of this course is to introduce the nuclear physics applications and instrumentation of particle counters and understand the importance of tomography.

	LEARNING OBJECTIVES	**STUDENT OUTCOMES**						
	At the end of the course, student will be able to							
1.	Measure the radiation background, magnetic moment of protons and electrons.							
2.	Develop new techniques to detect background radiation.							

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	To observe Brownian movement in charged oil droplets and determine the quantum nature of charge	6	I,O		1,2
2.	To determine magnetic moment and electron g factor of an electron	6	I,O		1,2
3.	Resonance Absorption of a high frequency oscillating circuit and variation of resonance frequency on magnetic field	6	I,O		1,2
4.	To determine magnetic moment of a proton and nucleus	6	I,O		1,2
5.	Determination of nuclear g-factor and carry out Nuclear Spin tomography	6	I,O		1,2
6.	Plotting a Geiger Plateau characteristics curve and to study the background radiation	6	I,O		1,2
	Total contact hours (Experiments +Demo + Extra class)	36			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	William R. Leo, "Techniques for Nuclear and Particle Physics Experiments: A How-to Approach" Springer Publications, US, 1987 [ISBN: 9783540572800]
2	Dorin N. Poenaru, Walter Greiner, "Experimental Techniques in Nuclear Physics", 1997 [ISBN: 3110144670]

Course nature				**Theory**	
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Experiments	Record/ Observation note	Viva Voce + Model examination	**Total**
	Weightage	**20%**	**10%**	**20%**	**50%**
				End semester examination Weightage :	**50%**

PHY 313	**Department Elective**
PHY317	**Department Seminar/Industry-Academic Visit**
OE	**Open Elective**