Dr. AMBEDKAR GOVERNMENT ARTS COLLEGE
(AUTONOMOUS)
CHENNAI - 600 039
(Accredited by NAAC at level "B")

B. Sc., PHYSICS
(FOR CANDIDATES ADMITTED FROM 2022-23 ONWARDS)

Syllabus

Under Choice Based Credit System
LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)

DEPARTMENT OF PHYSICS

Based on UGC – Learning Outcomes-Based Curriculum Framework
Course Structure under Choice Based Credit System
(For the candidates admitted from the academic year 2022-2023 onwards)

Sem. No	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
I	I	LC - I	22UAFTA1	General Tamil - I	6	3	3	25	75	100
	II	ELC - I	22UACEN1	Communicative English - I	4	3	3	50	50	100
	III	CC - I	22UAPHC1	Mechanics and Properties of Matter	6	4	3	25	75	100
	III	CCP*	Even Sem.	**Major Practical I**	3	-	-	40	60	100
	III	AC - I	22UAMAA1	Allied Mathematics – I	7	5	3	25	75	100
	IV	NME - I		Non Major Elective-I Subjects offered by the other department	2	2	3	25	75	100
	IV	SBE - I	22UAPPS1	Professional English for Physical Sciences – I	2	3	3	50	50	100
				Total	**30**	**20**				
II	I	LC - II	22UBFTA2	General Tamil - II	6	3	3	25	75	100
	II	ELC - II	22UBCEN2	Communicative English - II	4	3	3	50	50	100
	III	CC - II	22UBPHC1	Heat, Thermo-dynamics and Sound	6	4	3	25	75	100
	III	CCP - III	22UBPHC2	**Major Practical – I**	3	4	3	40	60	100
	III	AC - II	22UBMAA2	Allied Mathematics – II	7	5	3	25	75	100
	IV	NME - II		Non Major Elective-II Subjects offered by the other department	2	2	3	25	75	100
	IV	SBE - II	21UBPPS2	Professional English for Physical Sciences – II	2	3	3	50	50	100
				Total	**30**	**24**				

Sem. No	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
III	I	LC - III	22UCFTA3	General Tamil - III	6	3	3	25	75	100
	II	ELC - III	22UCLTS1	Language Through Literature - I	4	3	3	50	50	100
	III	CC - IV	22UCPHC1	Optics and Spectroscopy	6	4	3	25	75	100
	III	CCP**	Even Sem.	**Major Practical – II**	3	-	-	40	60	100
	III	AC - III	22UCCHA1	Allied Chemistry – I	4	3	3	25	75	100
	III	ACP**	Even Sem.	**Allied Chemistry Practical**	3	-	-	40	60	100
	IV	EVS	22UCEVS1	Environmental Studies	2	2	3	25	75	100
	IV	SBE - III	22UCSBE3	SS III – Personality Enrichment	2	3	3	40	60	100
				Total	**30**	**18**				
IV	I	LC - IV	22UDFTA4	General Tamil - IV	6	3	3	25	75	100
	II	ELC - IV	22UDLTS2	Language Through Literature - II	4	3	3	50	50	100
	III	CC - V	22UDPHC1	Atomic Physics	6	4	3	25	75	100
	III	CC - VI	22UDPHC2	**Major Practical – II**	3	4	3	40	60	100
	III	AC - IV	22UDCHA2	Allied Chemistry – II	4	3	3	25	75	100
	III	ACP - V	22UDCHA3	**Allied Chemistry Practical**	3	4	3	40	60	100
	IV	VBE	22UDVBE1	Value Based Education	2	2	3	25	75	100
	IV	SBE - IV	22UDSBE4	SS IV - Computer Basics and Office Automation	2	3	3	40	60	100
	V	Extension	22UDEXT1	Extension Activities	-	1	-	-	-	-
				Total	**30**	**27**				

Sem. No	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
V	III	CC - VII	22UEPHC1	Electricity and Electromagnetism	4	4	3	25	75	100
	III	CC - VIII	22UEPHC2	Analog and digital Electronics	4	4	3	25	75	100
	III	CC - IX	22UEPHC3	Classical and Statistical Mechanics	4	4	3	25	75	100
	III	CC - X	22UEPHC4	Relativity and Quantum Mechanics	4	4	3	25	75	100
	III	CCP***	Even Sem.	Major Practical – III	3	-	-	40	60	100
	III	CCP***	Even Sem.	Major Practical – IV	3	-	-	40	60	100
	III	CCP***	Even Sem.	Major Practical - V	3	-	-	40	60	100
	III	CEC - I	*	One from the Elective-I Subjects	5	5	3	25	75	100
				Total	**30**	**21**				
VI	III	CC - XI	22UFPHC1	Nuclear Physics	5	4	3	25	75	100
	III	CC - XII	22UFPHC2	Solid State Physics	6	4	3	25	75	100
	III	CC - XIII	22UFPHC3	Major Practical – III	3	4	3	40	60	100
	III	CC - XIV	22UFPHC4	Major Practical – IV	3	4	3	40	60	100
	III	CC - XV	22UFPHC5	Major Practical - V	3	4	3	40	60	100
	III	CEC - II	#	One from the Elective-II Subjects	5	5	3	25	75	100
	III	CEC - III	##	One from the Elective-III Subjects	5	5	3	25	75	100
				Total	**30**	**30**				
				Total Credits	**180**	**140**				

**** - Practical at the end of second semester.**

***** - Practical at the end of fourth semester.**

CORE ELECTIVE COURSES:

Elective-I (Any one subject of the following Core Elective chosen by the candidate)		**Elective-II** (Any one subject of the following Core Elective chosen by the candidate)		**Elective-III** (Any one subject of the following Core Elective chosen by the candidate)	
***Sub. Code**	**Core Elective Courses**	**#Sub. Code**	**Core Elective Courses**	**##Sub. Code**	**Core Elective Courses**
22UEPHE1A	**Microprocessor Fundamentals**	22UFPHE2A	**Energy Physics**	22UFPHE3A	**Optoelectronics**
22UEPHE1B	Mathematical Physics	22UFPHE2B	Nanophysics	22UFPHE3B	Medical Physics
22UEPHE1C	Spectroscopy				
22UEPHE1D	Computer Programming in C++				

The Department of Physics offers non-major elective to other department:

NON- MAJOR ELECTIVE COURSE:

I Semester (Any one subject of the following Non Major Elective chosen by the candidate)		**II Semester** (Any one subject of the following Non Major Elective chosen by the candidate)	
@Sub. Code	**Non Major Elective**	**@@Sub. Code**	**Non Major Elective**
22UAPHN1A	**Fundamentals of Physics –I**	22UBPHN2A	**Fundamentals of Physics – II**
22UAPHN1B	Energy Physics	22UBPHN2B	Laser Physics

ALLIED PHYSICS FOR MATHEMATICS, CHEMISRY AND COMPUTER SCIENCE

Course code	Name of the paper
22UCPHA1	Allied Physics-I
22UDPHA2	Allied Physics-II
22UDPHA3	Allied Physics Practical

SEMESTER-I

B.Sc. DEGREE PROGRAMME IN PHYSICS

First Semester				
Course Title		**MECHANICS AND PROPERTIES OF MATTER**		
Course Code		22UAPHC1		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-I	Core	4	6	25+75=100

Course Objectives

The main objectives of this course are:

1. To make the students effectively achieve an understanding of Mechanics
2. To give the students about fundamental ideas on conservation laws, the behaviour of rigid body dynamics, the definition of centre of gravity and centre of pressure and analyse the performance of hydrodynamics
3. To expose the students about the fundamental properties of matter
4. To study about bending behaviour beams and analyse the expression for young's modulus
5. To understand the basics of fluid dynamics and its application

Unit 1 : Impulse and Impact **18 hours**

Impulse – impact – Fundamental laws of impact – direct impact and oblique impact between two smooth spheres – loss of kinetic energy due to direct impact and oblique impact – motion of two interacting bodies – reduced mass.

Rigid body dynamics

Compound pendulum – theory – determination of g and k – center of mass – velocity and acceleration of centre of mass – system of variable mass.

Unit 2 : Centre of gravity and centre of pressure **18 hours**

Centre of gravity of solid tetrahedron, solid and hollow hemisphere – Centre of pressure – vertical rectangular lamina – vertical triangular lamina.

Hydrodynamics

Equation of continuity of flow – Venturimeter – Euler's equation of unidirectional flow – Torricelli's theorem – Bernoulli's theorem and its applications.

Unit 3 : Elasticity **18 hours**

Hooke's Law – Stress – Strain - Elastic constants – Expressions for Poisson's ratio interms of elastic constants – workdone in stretching and twisting a wire – rigidity modulus by static torsion – torsional pendulum – rigidity modulus and moment of inertia.

Unit 4 : Bending of beams **18 hours**

Cantilever – expression for bending moment – Experiment to find Young's modulus – Non uniform bending – Experiment to determine Young's modulus by Koenig's method – uniform bending – expression for elevation – experiment to determine Young's modulus using microscope.

Unit 5 : Fluid dynamics **18 hours**

Surface tension-Definition – Excess of pressure over curved surface – Application to spherical and cylindrical drops and bubbles – Determination of Surface tension of a liquid by Jaegar's method -variation of surface tension with temperature –. Viscosity-Definition – Coefficient of viscosity – Rate of flow of liquid in a capillary tube – Poiseuille's formula and experimental determination of viscosity of liquid

Books for Study

1. Mechanics – Part I and II by Narayanamoorthy, National Publishing Company.
2. Mechanics by D.S.Mathur, S.Chand& Co., 2nd Edition (2001).
3. Mechanics by P. Duraipandian, LaxmiDuraipandian, MuthamizhJayapragasam,S.Chand& Co., New Delhi (1988).
4. Properties of Matter by BrijLal and N.Subramaniam, S. Chand & Co., New Delhi (1994).
5. Properties of Matter by R.Murugeshan, S. Chand & Co., New Delhi (2001).

Books for Reference

1. General Properties of Matter by C.J. Smith, Orient Longman Publishers (1960).
2. Fundamentals of Physics by D. Halliday, R.Rensick and J. Walker, 6th edition, Wiley, NY (2001).
3. Mechanics and General Properties of Matter by P.K. Chakrabarthy, Books and Allied (P) Ltd. (2001).
4. Fundamentals of General Properties of Matter by H.R.Gulati, S. Chand & Co., New Delhi (1982).

Website:

nptetl.iitm.ac.in

Methodology of Teaching:

Chalk and talk, seminars, group discussions, hands on training, assignment

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	Learn about the behaviour of physical bodies and the basic concepts related to the motion of all the objects	K1, K2, K4
CO2	Apply the concept of centre of gravity and centre of pressure to some materialistic systems and hydrodynamics in everyday applications	K1, K2, K3
CO3	Learn the basics of properties of matter, how Young's modulus and rigidity modulus are defined and how they are evaluated for different shapes of practical relevance	K1, K2, K3, K4
CO4	Identify materials suitable for construction of buildings and bridges based on the moduli of elasticity	K1, K2, K3, K5
CO5	Understand Viscosity and surface tension and its applications in our day to day life	K1, K2, K4
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating ,		

K6–Creating.

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2		2	1		
CO2	2		2	1		
CO3	3		2	2		2
CO4	2	2	1	2		2
CO5	2		1	1		
Total	11	2	8	7		4
Average	2.2	0.4	1.6	1.4		0.8

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER-II

B.Sc. DEGREE PROGRAMME IN PHYSICS

Second Semester				
Course Title		HEAT, THERMODYNAMICS AND SOUND		
Course Code		**22UBPHC1**		
Course No.	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-II	Core	4	6	25+75=100

Course objectives:

The main objectives of this course are:

1. To provide knowledge on heat, thermodynamics, and sound fundamentals.
2. To help students understand basic experimental concepts in heat and sound.
3. To enlighten understanding of concepts in specific heat capacity of elements, low temperature physics and conduction and radiation.
4. To know all basic laws in thermodynamics and their importance in the Carnot engine.
5. To acquire enough knowledge of sound basics and its high frequency called ultrasonics and their production.

Unit 1 : Thermometry and Calorimetry & Low temperature physics : 18 hours

Specific heat capacity – Specific heat capacity of solids – Dulong and Petit's law – Specific heat capacity of liquid – method of mixtures – Barton's correction – Specific heat capacity of gases –Mayer's relation for C_p and C_v , $C_v$by Joly's differential steam calorimeter and C_p by Regnault's method

Joule-Kelvin effect – porous plug experiment –Temperature of inversion (definition only)- Linde's method of liquefying air

Unit 2: Conduction and Radiation 18 hours

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe's method – thermal conductivity of a bad conductor – Lee's disc method – radiation – blackbody radiation – Wien's law – Stefan's law – Newton's law of cooling from Stefan's law

Unit 3 : Thermodynamics 18 hours

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics-Heat engine – Carnot's engine – Carnot's theorem – thermodynamic or absolute scale of temperature-Entropy – entropy and available energy – temperature – entropy diagram for Carnot's cycle - III Law of thermodynamics – Nernst's heat theorem-Maxwell's thermodynamic relations

Unit 4: Sound 18 hours

Simple Harmonic Motion –Composition of two S.H.M in a straight line-at right angles-Lissajous's figures-Free, Damped, Forced vibrations - Resonance

Laws of transverse vibration of strings - Sonometer-Determination of AC frequency using sonometer - Determination of frequency using Melde's apparatus-Decibels - Intensity levels - decibel-noise pollution

Unit 5 :Ultrasonics **18 hours**

Ultrasonics – production – piezoelectric crystal method – magnetostriction method – applications. Acoustics of buildings – reverberation – Absorption coefficient – Sabine's formula – Acoustics aspects of halls and auditoriums.

Books for study

1. Heat and Thermodynamics by D.S.Mathur, 3rd edition Sulthan Chand & Sons, New Delhi (1978).
2. Heat and Thermodynamics by Brijlal and N. Subramanyam, S.Chand& Co, New Delhi (2000).
3. Heat by Narayanamoorthy and KrishnaRao, Triveni Publishers, Madras (1969).
4. Text book of Sound by V.R.Khanna and R.S.Bedi, 1st edition, Kedharnaath Publish &Co, Meerut (1998).
5. Text book of Sound by Ghosh, S.Chand& Co, New Delhi (1996).

Books for Reference

1. Heat and Thermodynamics by Zemansky, McGraw – Hill Book Co. Inc., New York.
2. Fundamentals of Physics byResnickHalliday and Walker, 6th edition, , John Willey and Sons, Asia Pvt.Ltd., Singapore.
3. Fundamentals of Thermodynamics by Carroll M.Leonard, Prentice-Hall of India (P) Ltd., New Delhi (1965).
4. Heat and Thermodynamics by J.B.Rajam and C.L.Arora, 8th edition, S.Chand& Co. Ltd., New Delhi (1976).

Website: nptel.iitm.ac.in

Methodology of teaching:

Class lectures, group discussion assignments, MCQ's, Animation

COURSE OUTCOMES (CO):

Upon completion of this course, the students

CO	Course Outcomes	K - Levels
CO1	Would have a deeper knowledge of fundamentals	K1, K2
CO2	Would have a broad understanding of the basic experimental concepts of heat and sound.	K1, K2, K3
CO3	Would have understood and developed ideas of concepts to apply all with practical applications to solve the problems	K1, K2, K3, K4
CO4	Would gain knowledge from all basic laws and Carnot engine and have an idea about engine design.	K1, K2, K4
CO5	Would gain knowledge of sound and ultrasonics and its applications.	K2, K3, K4
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1		1		
CO2	2	1			1	
CO3	2	2	1	2		1
CO4	2	2	2		1	2
CO5	1	2	2	2		3
Total	9	8	5	5	2	6
Average	1.8	1.6	1	1	.4	1.2

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Second Semester				
Course Title		**Major Practical – I (Practical exam at the end of Second semester)**		
Course Code		**22UBPHC2**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CCP-III	Core practical-I	4	3	40+60=100

Course Objectives:

The main objectives of this course are:

1. Introduce students to the methods of Experimental Physics
2. Translate the concepts learnt in the lecture sessions to the laboratory sessions
3. Provide hands on experience in measuring the basic concepts in properties of Matter, Heat, Sound, Optics, Electricity and Magnetism
4. Develop skill in setting up the experiments, data analysis and accuracy of measurements
5. Plot graphs for better understanding and do error analysis

1. Young's modulus – Non-uniform bending – Pin & microscope
2. Young's modulus – Non-uniform bending – Optic lever& telescope
3. Rigidity modulus – Torsion pendulum (without identical masses)
4. Rigidity modulus and moment of inertia – Torsion pendulum (With identical masses)
5. Surface tension and interfacial surface tension – drop weight method
6. Comparison of co-efficient of viscosities of two liquids – Graduated burette
7. Sonometer – Determination of frequency of tuning fork
8. Specific heat capacity of a liquid – Newton's law of cooling
9. Thermal conductivity of a bad conductor – Lee's disc method
10. Determination of wavelength using diode laser source
11. Spectrometer – refractive index of a solid prism
12. P.O. Box – specific resistance of a coil
13. Potentiometer – Internal resistance of a cell
14. Potentiometer – calibration of low range voltmeter

Note : Use of Digital balance is permitted

Books for reference:

1.A text book of practical physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan
2. Practical Physics and Electronics by C.C.Ouseph, U.J.Rao and Vijayendran, S.Viswanathan (Printers & Publishers) Pvt., Ltd (2007).

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Understand the usage of basic laws and theories to determine various properties of the matter given	K1, K2, K3, K4
CO2	Use standard methods to calibrate the given low range voltmeter and to measure resistance of the given coil and various physical quantities	K1, K2, K3, K4
CO3	Use of basic laws to study the thermal properties of matter, spectral properties and optical properties of the given prism	K1, K2, K3, K4
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	3		
CO2	2	2	1	3		
CO3	2	2	1	3		
Total	6	6	3	9		
Average	2	2	1	3		

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

SEMESTER-III

B.Sc. DEGREE PROGRAMME IN PHYSICS

Third Semester				
Course Title		**OPTICS AND SPECTROSCOPY**		
Course Code		**22UCPHC1**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-IV	Core	4	6	25+75=100

Course Objectives:

The main objectives of this course are

1. To understand sufficient basic knowledge about the fundamental phenomena of light
2. To study the importance of optics and gain knowledge of geometrical and physical optics
3. To apply the idea of interference in finding the thickness of wire and thin film
4. To analyse the tools needed to formulate problems in optics and spectroscopy
5. To enable the students to impart the knowledge related to the concepts and techniques of spectroscopy

Unit 1 : Geometrical Optics 18 hours

Spherical aberration in lenses - methods of minimizing spherical aberration - condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in and out of contact) - Dispersion produced by a thin prism - Combination of prisms to produce - Dispersion without deviation - Deviation without dispersion.

Unit 2 : Interference 18 hours

Analytical treatment of interference - expression for intensity - condition for maxima and minima in terms of phase and path difference - Airwedge - determination of diameter of thin wire - Michelson's interferometer - theory - applications - determination of wavelength; thickness of thin transparent material and resolution of interferometer.

Unit 3 : Diffraction 18 hours

Fresnel diffraction - diffraction at a circular aperture and narrow wire. Fraunhoffer diffraction - single slit - double slit - (simple theory). Plane diffraction grating - Determination of wavelengths using grating - normal incidence - oblique incidence (theory).Dispersive power of a grating-Resolving power of grating - Difference between resolving power and Dispersive power.

Unit 4 :Polarisation 18 hours

Double refraction - Nicol prims -polarizer and analyzer - Huygen's explanation of double refraction in uniaxial crystals - Quarter wave plate and Half wave plate - plane, elliptically and

circularly polarized light - production and detection - optical Activity - Fresnel's explanation of optical activity - specific rotatory power - determination using Laurent's half shade polarimeter.

Unit 5: Spectroscopy **18 hours**

Introduction to spectroscopy - Electromagnetic spectrum –characteristics of electromagnetic radiation - quantization of energy - regions of the spectrum – classification of molecules – rigid rotator - vibrational spectroscopy – harmonic oscillator - Raman effect - experimental set up - Characteristics of Raman lines

Books for Study :

1. A Text book of Optics by Subrahmanyam N., BrijLal and M.N. Avadhanulu, S.Chand & Co., New Delhi(2006).
2. Optics by Khanna D.R. &Gulati H.R., S.Chand& Co., New Delhi (1979).
3. Optics and Spectroscopy by R.Murugeshan and KiruthigaSivaprasath, S. Chand & Co., New Delhi (2006).
4. Molecular structure and spectroscopy by Aruldhas, Prentice Hall of India Pvt. Ltd., New Delhi (2005).

Books for Reference :

1. Fundamentals of Physics, by D.Halliday, R. Resnick and J. Walker, Wiley, 6th Edition, New York (2001).
2. Optics by Ajay Ghatak, Tata McGraw-Hill publishing Co. Ltd., New Delhi(1998).
3. Spectroscopy by GurdeepChatwal, Sham Anand, Himalaya Publishing House(1990).

Website:

nptel.iitm.ac.in

Methodology of teaching:

Chalk and talk, powerpoint and video presentations, assignments, MCQs

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	Distinguish the different types of Dispersion, Deviation, Aberrations and achromatism	K1, K2, K3, K4
CO2	Understand the basic ideas of Interference of Light and calculate wavelength difference and fringe width from the interference pattern	K1, K2, K3
CO3	**Apply** their understanding of diffraction pattern and calculate dispersive power of grating, and Resolution	K1, K2, K4
CO4	Analyse different types of polarized light, Optical activity, specific rotator power	K1, K2, K3, K4
CO5	**Analyze** the prerequisite in a molecule towards its rotational and vibrational activity.	K1, K2, K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1			1
CO2	2	1	2	1		
CO3	2	1	1			
CO4	1	1		1	1	
CO5	2	2	3	2		1
Total	9	6	7	4	1	2
Average	1.8	1.2	1.4	0.8	0.2	0.4

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER - IV

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fourth Semester				
Course Title		**ATOMIC PHYSICS**		
Course Code		**22UDPHC1**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-IV	Core	4	6	25+75=100

Course objectives:

The main objectives of this course are:

1. To understand the basics characteristic of nature of atoms.
2. To study the theoretical and experiments of atomic structure.
3. To study both experimental and theoretical studies on simpler atoms like hydrogen.
4. To study properties positive rays and various mass spectrograph.
5. To study Bragg's law of crystal structure and its experimental methods using X rays.
6. To understand the photoelectric effect and is applications.

Unit I:ELECTRON THEORY OF SOLIDS **18 hours**

The free electron theory of metals – expressions for electrical conductivity – thermal conductivity – Wiedman-Franz's law-Hall effect-magneto resistance-determination of electronic charge – Millikan' s oil drop method – electron microscope

Unit II:POSITIVE RAYS: **18 hours**

Discovery-properties- analysis – Thomson's parabola method – Aston's mass spectrograph – Bainbridge's mass spectrograph – Dempster's mass spectrograph – Dunnington's method of determining e/m.

Unit III : ATOMIC STRUCTURE **18 hours**

Early atomic spectra-Thomson model-Alpha particle scattering-Rutherford 's nuclear model-drawbacks-Bohr atom model –Bohr's interpretation of the Hydrogen spectrum-correction for nuclear motion-evidences in favour of Bohr's theory-Ritz combination principle-ccorrespondence principle-Sommerfeld'srelativistic atom model-drawbacks- the vector atom model – Quantum numbers associated with the vector atom model —Pauli's exclusion principle – periodic classification of elements

Unit IV:FINE STRUCTURE OF SPECTRAL LINES **18 hours**

Coupling schemes-L-S Coupling-j-j Coupling- Hund rules- magnetic dipole moment due to orbital motion of the electron- due to spin of the electron - Stern and Gerlach experiment-spin-orbit coupling-optical spectra-spectral terms-spectral notation- selection rules- intensity rules-interval rule- fine structure of sodium D line- hyperfine structure- Normal Zeeman effect- theory and experiment- quantum mechanical explanation - Larmor's theorem- Anomalous Zeeman effect- Paschen –Back effect-Stark effect.

Unit V:X-Rays and **Photo Electric Effect** **18 hours**

Production of X-rays – properties-absorption of X-rays – X-ray absorption edges- Bragg's law – Bragg's X-ray spectrometer –the powder crystal method –Laue's method – Rotating crystal method –X-ray spectra- continuous spectra- characteristic spectra-Moseley's law -importance– width of spectral lines-Doppler broadening-collision broadening-X-ray Detectors-scintillation detector-semiconductor detectors-Compton effect- theory and experimental verification.

Photo Electric Effect-Einstein's photoelectric equation-photoelectric cells-photo emissive cells-photovoltaic cells-photoconductive cells-applications of photoelectric cells

B**ooks for Study:**

1. Modern Physics by R. Murugeshan, KiruthigaSivaprasath, S. Chand & Co., New Delhi(2008).
2. Modern Physics by D.L.Sehgal, K.L.Chopra and N.K.Sehgal. Sultan Chand & Sons Publication, 7th Edition, New Delhi(1991).
3. Atomic Physics by J.B. Rajam, S. Chand & Co., 20thEdition, New Delhi (2004).
4. Atomic and Nuclear Physics by N. Subrahmanyam and BrijLal, S. Chand & Co. 5thEdition, New Delhi(2000).

Book for Reference :

1. Modern Physics by J.H. Hamilton and Yang, McGraw-Hill Publication, (1996).
2. Concepts of Modern Physics by A. Beiser, Tata McGraw-Hill, New Delhi (1997).
3. Fundamentals of Physics by D.Halliday, R.Resnick and J. Walker, Wiley, 6thEdition, New York(2001).
4. Modern Physics by Kenneth S.Krane, John Willey & sons, Canada (1998).

Website:

nptel.iitm.ac.in

Methodology of teaching: Chalk and talk, video presentations

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	To understand about the classification of solids on the basis of band theory	K1, K2, K3, K4
CO2	To Understand about various types of mass spectrographs	K1, K4, K5
CO3	To understand about atom models and quantum numbers	K5, K2, K3, K4
CO4	To study the Production/applications of X rays	K2, K3, K4
CO5	To study the functions of various Photoelectric cell and its applications.	K2, K3
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2				1
CO2	2	2		2	5	
CO3	1	2	2	2	3	
CO4	2	1			1	
CO5	2	2		3		3
Total	8	9	2	7	9	4
Average	2	1.8	.2	1.4	1.8	.8

Level of Correlation between PSO's and CO's
Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

	Fourth Semester				
	Course Title		**MAJOR PRACTICAL – II (practical exam at the end of II semester)**		
	Course Code		**22UDPHC2**		
	Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
	CC-VI	Core PRACTICAL	4	3	40+60=100

Course Objectives:

The main objectives of this course are

1. To apply the knowledge of physics fundamentals and instrumentations to arrive solution for various problems.
2. To understand the usage of basic laws and theoretical part to determine various properties of materials given.
3. To make the students understand the concepts of acoustics
4. To allow the students use basic laws to study the spectral properties and optical properties of the grating and prism
5. To allow the students to have a deep knowledge of the fundamentals of electricity and magnetic circuits

1. Young's modulus - cantilever - depression - Static method - Scale and telescope
2. Young's modulus-Uniform bending- single optic lever and telescope
3. Static torsion – Rigidity modulus of the material of the rod
4. Compound pendulum –determination of g and k
5. Melde's String – Frequency, Relative Density of a solid and liquid
6. Spectrometer- i-d Curve
7. Spectrometer - Grating N and λ - normal incidence method
8. Spectrometer - Grating N and λ - minimum deviation method
9. Spectrometer-Determination of refractive index of liquid-hollow prism
10. Carey Foster bridge - resistance of a coil
11. Determination of m and B_H – Tan B position
12. Potentiometer - Ammeter calibration
13. Figure of merit of galvanometer (Spot Galvanometer Or Table Galvanometer)
14. Airwedge- Determination of thickness of a thin wire
15. Sonometer- Frequency of AC mains using steel and brass wire

Note: Use of Digital balance is permitted

Books for reference:

1.A text book of practical physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan

2. Practical Physics and Electronics by C.C.Ouseph, U.J.Rao and Vijayendran, S.Viswanathan (Printers & Publishers) Pvt., Ltd (2007).

Course outcomes

Upon completion of this course, the students will be able to

CO	Course Outcomes	K - Levels
CO1	Familiarize with apparatus for mechanical, optical and electrical experiments for accurate measurements of physical parameters	K1, K2, K3
CO2	Develop **skill** in setting up of apparatus for accurate measurement of physical parameters	K1, K2, K3, K4
CO3	**Gain conceptual** understanding skill in a systematic way of measurements so as to minimize the possible errors and Analyze them by plotting graphs	K1, K2, K3, K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO- PSO Mapping (Course Articulation Matrix)

CO / PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2		2	1		
CO2	1	1		2		
CO3	2			1		
Total	5	1	2	4		
Average	1.67	0.3	0.6	1.3		

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

SEMESTER-V

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**ELECTRICITY AND ELECTROMAGNETISM**		
Course Code		**22UEPHC1**		
Course No	**Course Category Core/Elective**	**No of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-VII	Core	4	4	25+75=100

Course objectives:

The main objectives of this course are:

1. To understand the basic laws and concepts in the effect of magnetism on electric current
2. To acquire knowledge of thermal and chemical effect of current
3. To know the concepts and uses of electromagnetic induction
4. To explore the concepts of ac and dc current related in everyday applications
5. To analyze the propagation of electromagnetic wave in free space.

UNIT-1 :MAGNETIC EFFECT OF ELECTRIC CURRENT 12 hours

Magnetic flux and magnetic induction- BiotSavart law- magnetic induction at a point due to a straight conductor carrying current - magnetic induction at a point on the axis of a circular coil carrying current- amperes circuital law-magnetic field inside a long solenoid- Lorent'z force on a moving charge- direction of force-torque on a current loop in a uniform magnetic field - Moving coil Ballistic galvanometer-theory -experiment to find charge sensitivity and absolute capacity of a capacitor

UNIT-II: THERMAL AND CHEMICAL EFFECT OF ELECTRIC CURRENT 12 hours

Thermoelectricity- Seebeck effect- laws of thermo e.m.f-– measurement of thermo e.m.f using potentiometer-Peltier effect-demonstration—Thomson effect- demonstration - thermodynamics of thermo couple –thermo electric diagram –uses

Faradays laws of electrolysis- electrical conductivity of an electrolyte-specific conductivity- Kohlrausch's bridge method of determining the specific conductivity of an electrolyte -Arrhenius theory of electrolytic dissociation- Accumulators-lead accumulators-alkali accumulator-standard cadmium cell

UNIT-III: ELECTROMAGNETIC INDUCTION 12 hours

Faraday's laws of electromagnetic induction-self induction –self inductance of a long solenoid -mutual induction-mutual inductance between two co-axial solenoids-experimental determination of mutual inductance –-coefficient of coupling - eddy currents-uses - Earth inductor-uses-search coil- induction coil and its uses

UNIT-IV: AC AND DC CIRCUITS 12 hours

Growth and decay of current in LC,LR and CR circuits with d.c.voltages - determination of high resistance by leakage –growth and decay of charge in LCR circuit-conditions for the discharge to be oscillatory –frequency of oscillation.

Alternating Current-Resistance in an AC circuit-Inductance in an AC circuit- Capacitance in an AC circuit-AC through an inductance and resistance in series- capacitance and resistance in series – LCR series resonance circuit -sharpness of resonance-parallel resonance circuit -power in an AC circuit-power factor

UNIT-V: MAXWELL'S EQUATION & ELECTROMAGNETIC WAVES 12 hours

Introduction- Maxwell's equations- -Displacement current- Poynting vector-Electromagnetic waves in free space-Hertz experiment for production and detection of EM waves.

Books for study

1 Electricity and Magnetism,. R. Murugeshan, (2008) S Chand & Co, New Delhi
2. Electricity and Magnetism BrijLal&Subramanyam, ,(2005)RatanPrakashanMandir Publishers, Agra
3. Electricity & Magnetism M.Narayanamurthy&N.Nagarathnam, , NPC pub., Revised edition.

Books for Reference

1. Electricity and Magnetism -D.N.Vasudeva (Twelfth revised edition)
2. Electricity and Magnetism - K.K.Tiwari (S.Chand&Co.)
3. Electricity and Magnetism -E.M.Pourcel,Berkley Physics Cource, Vol.2 (McGrraw-Hill)
4. Electricity and Magnetism -Tayal (Himalalaya Publishing Co.)
5. David J. Griffith, Introduction to Electrodynamics, (2012) PHI, New Delhi

Web Site :

http://www2.warwick.ac.uk/fac/sci/physics/teach/ module-home/px207.
www.core.org.cn/ocw web/physics/8-311 spring 2004/lecture notes.
nptel.iitm.ac.in

Methodology of teaching:

chalk and talk, power point presentations, hands on training

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Apply the laws and principles to determine the magnetic effect on current	K1, K2, K3
CO2	Analyze the behavior of thermal and chemical effect of current	K1, K2, K3, K4
CO3	Explore the knowledge of electromagnetic induction in various applications	K1, K2, K3
CO4	Acquire the basic ideas of AC and DC circuits and enhance problem solving skills	K1, K2, K3, K4
CO5	Summarize the concept of electromagnetic waves to discuss Maxwell equations	K1, K2, K3
K1-Remembering, **K2**-Understanding, **K3**-Applying, **K4**-Analyzing, **K5**-Evaluating, **K6**-Creating.		

CO-PSO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2				1
CO2	2	1				
CO3	1	1	1	2		
CO4	2	1			1	
CO5	1	2	3	2		
Total	8	7	4	4	1	
Average	1.6	1.4	.8	.8	.2	

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**ANALOG AND DIGITAL ELECTRONICS**		
Course Code		**22UEPHC2**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-VIII	Core	4	4	25+75=100

Course objectives:

The main objectives of this course are

1.To enable students understand the fundamentals of semiconductor devices
2. To learn the different modes of operations of transistors and multivibrators
3.To acquire knowledge on operational amplifiers and timer
4. To make students understand the digital fundamental circuits
5. To develop skill to construct logic circuits and implement

Unit I: Semiconductor devices **12 hours**

PN junction theory - V-I characteristics of a PN junction diode - Zener diode - equivalent circuit - voltage regulator -Field effect Transistor FET-MOSFET- UJT-SCR -characteristics - FET as a VVR-UJT relaxation oscillator-SCR as a switch and rectifier

Unit II: Transistor Amplifier, oscillators and Multivibrator **12 hours**

Transistor - Different modes of operations-CB mode &CE mode- RC coupled amplifier – Emitter follower. Feedback principle -effect negative feedback-and Barkhaussen criterion - Phase shift and Wien Bridge oscillators using transistors –Expression for frequency- Multivibrators-Astable, Monostable and Bistable multi vibrators using transistors - Schmitt trigger

Unit III: Operational Amplifier & Timer **12 hours**

Operational Amplifier- characteristics-parameters-applications- Inverting amplifier - Non inverting amplifier - Adder - Subtractor - Integrator – Differentiator- Solving simultaneous equations-comparator -square wave generator -Wien bridge oscillator - 555 timer, block diagram &working-astable&monostablemultivibrator -Schmitt trigger

Unit IV: Digital Fundamentals **12 hours**

Number Systems and Conversions -BCD Code - Gray code - 1's and 2's complements – Basic logic gates - NAND, NOR and EX-OR gates - NAND and NOR as Universal Building blocks - Laws and theorems of Boolean algebra –- NAND-NAND circuits - Karnaugh's map-SOP and POS- applications-Half adder-Full adder-Half subtractor-full subtractor.

Unit V :Sequential Logic **12 hours**

RS, Clocked RS, D, J-K and J-K Master-Slave Flip-flop - Shift registers and Counters-Multiplexers and Demultiplexers – Decoders and Encoders - Memory Circuits -D/A and A/D converters

Books for Study:

1. Hand Book of Electronics by Gupta and Kumar - PragatiPrakashan – Meerut(2002).
2. Principles of Electronics by V.K. Mehta, Rohit Mehta S. Chand &Co.(2006).
3. Electronics by M. Arul Thalapathi, ComptekPublishers(2005).
4. Elements of Electronics by M.K.Bagde and Singh S.P., S. Chand & Co., NewDelhi(1990).
5. Applied Electronics by A. Subramanyam – National Publishing Co.(1997)
6. OP - AMPs and Linear Integrated Circuits by Ramakant A. Gayakwad, PrenticeHall of India(1994).
7. Digital Principles and Application by Malvino Leach, Tata McGraw Hill, 4thEdition(1992).
8. Digital Fundamentals by Thomas L. Floyd, Universal Book Stall, New Delhi(1998).
9. Introduction to Integrated Electronics by V.Vijayendran, S. Viswanathan (Printersand Publishers) Pvt. Ltd., Chennai(2005).

Books for Reference

1. Electronic Devices by Mittal.G.K., G.K. Publishers Pvt. Ltd., (1993).
2. Basic Electronics by B.L. Theraja, S. Chand & Co., (2008).
3. Solid State Electronics by Ambrose and Vincent Devaraj, Meera Publication.
4. Applied Electronics by R.S. Sedha, S. Chand &Co.(1990).
5. Digital Electronics by Practice Using Integrated Circuits - R.P.Jain - Tata McGrawHill(1996).

Website:

nptel.iitm.ac.in

Methodology of Teaching:

Chalk and Talk, Power point presentation, group discussions, hands on training, website references, assignments

COURSE OUTCOMES (COs)

Upon completion of the course, the students

CO	COURSE OUTCOME	KNOWLEDGE LEVEL
CO1	Would possess sufficient knowledge on various semiconductor materials and its working	K1,K2,K3
CO2	Would understand the different modes of transistor and oscillator circuits, their working and applications in domestic, industrial and scientific devices	K1,K2,K3
CO3	Would design and solve Boolean algebra and Karnaugh maps	K1,K2,K3,k4
CO4	Would construct sequential logic circuits	K1,K2,K3
CO5	Would find job opportunities in research and development	K1,K2,K3, K4
K1-Remembering, **K2**-Understanding, **K3**-Applying, **K4**-Analyzing, **K5**-Evaluating, **K6**-Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1				2
CO2	1	1		1		1
CO3	1	1				1
CO4	1	1	2		2	2
CO5	1	1	2		2	2
Total	5	5	4	1	4	8
Average	1	1	0.8	0.2	0.8	1.6

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**CLASSICAL AND STATISTICAL MECHANICS**		
Course Code		**22UEPHC3**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-IX	Core	4	4	25+75=100

Course objectives:

The main objectives of this course are:

1. To understand the concept of mechanics of a system of particles.
2. To study and apply the mathematical techniques (differentiation and integration)on mechanics of simple systems.
3. To solve the mathematical formulation under various limiting conditions (constraints).
4. To study the basic of statistical concepts and to apply in mechanics.
5. To study different areas of statistical mechanics, various operators, Solving Schrodinger equation in spherical polar coordinates and matrix formulation of Quantum mechanics
6. To apply quantum statistics in studying the density of energy states.

UNIT I: Mechanics of a System of Particles **12 hours**

External and internal forces, centre of mass-Conservation of linear momentum-Conservation of angular momentum-Conservation of energy-work-energy theorem-Conservative forces-examples-Constraints-Types of constraints-Examples-Degree of freedom-Generalized coordinates (transformation equations)- Generalized velocities- Generalized Momentum.

UNIT II: Lagrangian Formulations **12 hours**

Principle of virtual work, D'Alembert's principle, Lagrange's equation of motion for conservative and non conservative systems-Simple applications-simple pendulum-Atwood's machine-compound pendulum- Hamilton's principle-Deduction of Lagrange's equation of motion from Hamilton's principle-Deduction of Hamilton's principle from D'Alembert's principle.

UNIT III: Hamiltonian Formulations **12 hours**

Phase space-The Hamiltonian function H -Hamilton's Canonical equation of motion-Physical significance of H- Deduction of Canonical equation from a variational principle-Applications-Harmonic oscillator-Compound pendulum

UNIT IV: Classical Statistics **12 hours**

Micro and macro states-The mu-space and gamma space-fundamental postulates of statistical mechanics-Ensembles-different types -Thermodynamical probability-entropy and probability-Boltzmann's theorem- Maxwell-Boltzmann statistics- Maxwell-Boltzmann energy distributive law

UNIT V: Quantum Statistics **12 hours**

Development of Quantum statistics- Bose - Einstein and Fermi - Dirac statistics - Derivation of Planck's radiation formula from Bose – Einstein statistics -Difference between classical and quantum statistics

Books for study

1. J.C. Upadhyaya, July 2005, **Classical Mechanics**, Published by Himalya Publishing House, Mumbai
2. Brijlal&Subramaniam, Reprint 1998, **Heat & Thermodynamics**, S. Chand & Company Ltd
3. Agarwal, **'Statistical Physics'** S.Chand& co New Delhi 1996

Books for Reference

1. Gupta,B.D., Satyaprakash, 1991, Classical Mechanics, 9th ed., KadernathRamnath Publ., Meerut
2. Gupta, Kumar, Sharma, 2005, **Classical Mechanics**, PragatiPrakashan Publ., Meerut.
3. Murray R.Spiegal, 1981, Theoretical Mechanics, Schaum's outline series, McGraw Hill Publ. Co., New Delhi.

Website: nptel.iitm.ac.in

Methodology of teaching: chalk and talk, video presentations

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	Gain knowledge in solving mechanics of particles.	K1, K2, K3, K4
CO2	To apply the concepts of classical mechanics to various simple systems (Simple pendulum)	K2, K3, K4
CO3	To apply mathematical concepts in statistical Mechanics	K2, K3, K4, K5
CO4	To understand and apply statistics in thermodynamics systems.	K1, K2, K3, K4
CO5	To study the various quantum statistics using mathematical formulation.	K1, K2, K3
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3		2			1
CO2	3	2	2			
CO3	3	1	1	2		
CO4	3	2	2		2	2
CO5	3	2	2	2		2
Total	15	7	9	4	2	5
Average	3	1.4	1.8	0.8	0.5	1

Level of Correlation between PSO's and CO's

Low : 1

Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**RELATIVITY AND QUANTUM MECHANICS**		
Course Code		22UEPHC4		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-X	Core	4	4	25+75=100

Course objectives:

The main objectives of this course are:

1. To acquire sufficient knowledge in the concept of relativity
2. To study dual nature of matter waves - both experimental and theoretical studies
3. To analyze evolution of quantum mechanics, Schrodinger equation and Operator Formalism
4. To find the commutation relation between various operators, Solving Schrodinger equation in spherical polar coordinates and matrix formulation of Quantum mechanics
5. To apply Schrodinger equation in various quantum mechanical problems

Unit I: Relativity **12 hours**

Frames of reference - Galilean transformation - Michelson - Morley experiment - Postulates of special theory of relativity - Lorentz transformation - length Contraction – time dilation - Relativity of simultaneity - addition of velocities - variation of mass with velocity– Mass energy relation - Elementary ideas of general relativity.

Unit II: Wave Nature of Matter **12 hours**

Phase and group velocity - wave packet - expression of De Brogile's wave length - Davisson and Germer's experiment - G.P.Thomson's experiment - Heisenberg's uncertainty principle and its consequences.

Unit III: Schrodinger Equation **12 hours**

Inadequacy of classical mechanics - Basic postulates of quantum mechanics -Schrodinger equation - Properties of wave function - Probability interpretation of wave function - linear operators - self adjoint operators - expectation value - eigenvalues and eigen functions.

Unit IV: Angular Momentum in Quantum Mechanics **12 hours**

Orbital angular momentum operators and their commutation relations - separation of three dimensional Schrodinger equations into radial and angular parts - Elementary ideas of spin angular momentum of an electron - Pauli matrices

Unit V: Solutions of Schrodinger Equation **12 hours**

Free particle solution - Particle in a box - linear harmonic oscillator-Eigen values and Eigen functions- Hydrogen atom-Separation of variables-Wave function and energy levels- Rectangular potential barrier- Quantum mechanical tunnelling(Qualitative study).

Books for Study

1. A Text book of Quantum mechanics by P.M.Mathews and S.Venkatesan, TataMcGraw - Hill, New Delhi(2005).
2. Quantum Mechanics by V.K.Thankappan, New Age International (P) Ltd.Publishers, New Delhi(2003).
3. Quantum mechanics by K.K.Chopra and G.C. Agrawal, Krishna PrakasamMedia(P) Ltd., Meerut First Edition(1998).
4. Modern Physics by R. Murugeshan and KiruthigaSivaprasath, S. Chand &Co.,(2008).

Books for Reference

1. Mechanics and Relativity by BrijlalSubramanyam, S.Chand& Co., New Delhi, (1990).
2. Concepts of modern physics by A.Beiser. Tata McGraw - Hill, 5th edition, NewDelhi(1997).
3. Introduction to quantum mechanics by Pauling and Wilson, McGraw – Hill.
4. Quantum mechanics by A.Ghatak and Loganathan, Macmillan India Pvt. Ltd.

Website:nptel.iitm.ac.in

Methodology of Teaching:

chalk and talk, video presentations, group discussions, animations, assignments

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	Gain knowledge in the concepts of Special theory of Relativity	K1, K2, K3, K4
CO2	Evolve ideas about the dual nature of matter	K2, K3
CO3	Recognize basic terms in Quantum Mechanics and different operator mechanism	K1, K2, K3, K4
CO4	Formulate basic theoretical problems in one, two and three dimensions and solve them	K2, K3, K4
CO5	Apply Schrodinger equation to various problems such as linear harmonic oscillator, quantum mechanical tunneling, hydrogen atom etc.	K2, K3, K4
K1-Remembering, **K2**-Understanding, **K3**-Applying, **K4**-Analyzing, **K5**-Evaluating, **K6**-Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2			2
CO2	3	2				
CO3	3	2	2	2	3	3
CO4	3	1			3	
CO5	3	3	3	2		
Total	15	10	7	4	6	5
Average	3	2	1.4	0.8	1.2	1

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**MIROPROCESSOR FUNDAMENTALS**		
Course Code		**22UEPHE1A**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CEC-1A	ELECTIVE	5	5	25+75=100

Course Objectives:

The main objectives of the course are

1. To become familiar with the architecture and its pin out
2. To describe the purpose of microprocessor internal registers
3. To impart the knowledge about instruction set of microprocessor - 8085
4. To develop assembly level language programming skills
5. To provide a strong foundation for designing real world applications using interfacing programs with microprocessor.

Unit 1 : Architecture **15 hours**

Architecture of 8085 – registers, flags, ALU, address and data bus, demultiplexing address/data bus – control and status signals – control bus, Programmer's model of 8085 –Pin out diagram – Functions of different pins.

Unit 2 : Programming Techniques **15 hours**

Instruction set of 8085 – data transfer, arithmetic, logic, branching and machine control group of instructions – addressing modes – register indirect, direct, immediate and implied addressing modes. Assembly language & machine language – programming techniques: addition, subtraction, multiplication, division, ascending, descending order, largest and smallest (single byte)

UNIT 3 : Interfacing memory to 8085

Memory interfacing – Interfacing 2kx8 ROM and RAM, Timing diagram of 8085 (MOVRd, Rs – MVI Rd, data(8)) .

Unit 4 : Interfacing I/O Ports to 8085

Interfacing input port and output port to 8085 – Programmable peripheral interface 8255– flashing LEDs

Unit 5 : Interrupts

Interrupts in 8085 - hardware and software interrupts – RIM, SIM instructions –priorities – simple polled and interrupt controlled data transfer.

Books of Study

1. Microprocessor Architecture programming and application with 8085 / 8080A.R.S.Gaonkar, Wiley Eastern Ltd.(1992).
2. Fundamental of microprocessor 8085 by V. Vijayendran, S.ViswanathanPublishers, Chennai (2003).
3. Fundamentals of Microprocessors and microcomputers by B.Ram - Dhanpat RAIpublication.

Books for Reference

1. Introduction to microprocessor by AdityaMathur - Tata Mc.Graw Hill Publishing Company Ltd.(1987).
2. Microprocessor and digital system by Dougles V. Hall - 2nd Edition - McGraw Hill Company (1983).

Website:

nptel.iitm.ac.in

Methodology of teaching:

Chalk and talk, powerpoint and video presentations, group discussions, hands on training

COURSE OUTCOMES (COs)

Upon completion of the course the student will be able to

CO	Course Outcomes	K - Levels
CO1	Assess and explain basics of microprocessor, its internal architecture and its operation within the area of manufacturing and performance	K1, K2
CO2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor	K1, K2, K3
CO3	Compare accepted standards and guidelines for the appropriate Microprocessor to meet specified performance requirements	K1, K2, K4
CO4	Design circuitry to the Microprocessor I/O ports in order to interface the processor to external devices. Draw the timing diagrams.	K1, K2, K3
CO5	Analyze and Evaluate assembly language programs; select appropriate assemble into machine a cross assembler utility code that will provide solutions real- world control problems	K3, K4, K5
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3		1	2		1
CO2	3	2	2	1		2
CO3	3	2	1			2
CO4	3	2		1	1	1
CO5	3	2	3	2		2
Total	15	8	7	6	1	8
Average	3	1.6	1.4	1.2	0.2	1.6

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**MATHEMATICAL PHYSICS**		
Course Code		**22UEPHE1B**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CEC-1B	ELECTIVE	5	5	25+75=100

Course Objectives

The main objectives of this course are

1. To introduce the students the concepts of mathematics in physics
2. To apply vector calculus and differential equations to various physics problems
3. To study the types and theorems in matrices
4. To gain insight into the Laplace transformation and partial differential equations

UNIT1 : VECTOR CALCULUS **15 hours**

Divergence and curl of a vector point function - Line Integral – Surface Integral – Volume Integral (without problem) – Gauss's Divergence theorem and it's proof - Deduction from Gauss theorem – Green's theorem in the plane - Stoke's theorem in space - simple problems.

UNIT – 2: DIFFERENTIAL EQUATION **15 hours**

` First-order differential equations - Separable variables -Exact equations-Integrating factors -Bernoulli's equation- Second-order equations with constant coefficients - Nature of the solution of linear equations - General solutions of the second-order equations - Finding the complementary function - Finding the particular integral - Rules for D operators - The Euler linear equation - Solutions in power series.

UNIT – 3: MATRICES **15 hours**

Introduction – special types of Matrices – Transpose of a Matrix – The Conjugate of a Matrix – Conjugate Transpose of a Matrix – Symmetric and Anti symmetric – Hermitian and skew Hermitian – Orthogonal and Unitary Matrices – Properties – Characteristics equation – Roots and characteristics vector – Diagonalization of matrices – inverse of a matrix - Cayley-Hamilton theorem – Problems

UNIT – 4: LAPLACE TRANSFORMATION **15 hours**

Definition of the Laplace transform - Existence of Laplace transforms - Laplace transforms of some elementary functions - Shifting (or translation) theorems - The first shifting theorem - The second shifting theorem - The unit step function - Laplace transform of a periodic function.

UNIT -5: PARTIAL DIFFERENTIAL EQUATIONS 15 hours

Linear second-order partial differential equations - Solutions of Laplace's equation: separation of variables - Solutions of the wave equation: separation of variables - Solution of Poisson's equation. Green's functions - Laplace transform solutions of boundary-value problems

Books for study

1.Mathematical Methods for Physicists: A concise introduction, - *TAI L.CHOW* -CAMBRIDGE UNIVERSITY PRESS.

Books for Reference

1.Mathematical physics- Piyooshkumartyagi , RBSA Publishers
2. Mathematical physics- Satyaprakash-Sultan Chand & Co:
3.Mechanics and mathematical physics -R.Murugesan- Sultan Chand & Co:
4. Mathematical physics-Gupta- Sultan Chand & Co.

Website:

nptel.iitm.ac.in

Methodology of teaching:

Chalk and talk, powerpoint and video presentations, problem solving

COURSE OUTCOMES (COs)

Upon completion of the course the student will be able to

CO	Course Outcomes	K - Levels
CO1	Demonstrate competence with the basic idea of vector calculus and differential equations and apply it to physical systems	K1, K2, K3, K4
CO2	Apply the knowledge of matrices to solve basic physics problems	K2, K3, K4
CO3	Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients	K2, K3, K4
CO4	Gain basic knowledge of partial differential equations which in turn is applicable in advanced problems involved in quantum mechanics	K1, K2, K3, K4
CO5	Develop good aptitude and problem solving skills	K4, K5
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3			
CO2	3	2	3			
CO3	3	2	3			
CO4	3	2	3			
CO5	3	3		2	2	
Total	15	11	12	2	2	
Average	3	2.2	2.4	0.4	0.4	

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**SPECTROSCOPY**		
Course Code		**22UEPHE1C**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CEC-1C	ELECTIVE	5	5	25+75=100

COURSE OBJECTIVE

The main objective of the course is to understand atomic and molecular spectra and the instrument techniques

Unit I: Microwave Spectroscopy **15 hours**

Rotation of molecules – Classification of molecules – Rotation spectra of diatomic molecules – Intensities of Spectral lines – Effect of Isotopic Substitution – Non-rigid rotator – Spectrum of a Non-Rigid Rotator –Polyatomic Molecules – Symmetric Top molecules – Asymmetric Top molecules -Techniques and Instrumentation – Chemical analysis by Microwave spectroscopy.

Unit II : Infrared Spectroscopy **15 hours**

I.R. Spectroscopy – Vibrating diatomic molecules – Simple Harmonic Oscillator - Anharmonic oscillator – Diatomic vibrating rotator – IR Spectrum of carbon monoxide - Interaction of rotations and vibrations – Vibration of Polyatomic molecules – Analysis by IR techniques.

Unit III :Raman Spectroscopy **15 hours**

Raman effect: Discovery – Quantum theory of Raman effect – Classical theory of Raman Effect –Pure rotational Raman Spectra- Linear molecules – Raman Spectrum of symmetric top molecules - Vibrational Raman spectra – Rule of mutual exclusion – Overtone and Combination Vibrations - Rotational Fine Structure – Polarization of light and the Raman Effect - Structure determination from IR and Raman spectroscopy.

Unit IV : Electronic spectroscopy **15 hours**

Born - Oppenheimer approximation – Vibrational coarse structure: Progressions – Frank-Condon principle – Dissociation energy and Dissociation products – Rotational Fine Structure of Electronic Vibration Transitions - Fortratdiagram -Predissociation – Diatomic molecules.

UnitV: Instrumentation **15 hours**

Instrumentation and Techniques in Infrared spectroscopy – Sources – monochromators – Sample cells – Detectors – Single beam Infra red spectrometer – Double beam Infra red spectrometer

Book For Study

1.Fundamentals Of Molecular Spectroscopy - Colin N Banwell Elaine- M MccashFifth Edition

Book For Reference

1.Molecular structure and spectroscopy - G. Aruldhas, PHI Learning Pvt. Ltd,India.
2.Hand book of Analytical Instruments -R.S. Khandpur, Tata MC Grow Hill Ltd

Website:

nptel.iitm.ac.in

Methodology of teaching:

Chalk and talk, powerpoint and video presentations, Assignment, MCQs

COURSE OUTCOMES (COs)

Upon completion of the course the student will be able to

CO	Course Outcomes	K - Levels
CO1	Understand basic concepts related to various spectroscopic techniques	K1, K2, K3
CO2	Study the theories behind the spectroscopic methods	K2, K3, K4
CO3	Gain insight into the instrumentations associated with spectroscopy and their applications in scientific studies	K2, K3
CO4	Get the aptitude of solving various spectrums	K3, K4, K5
CO5	Apply the concepts for further research	K3, K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1		
CO2	3	2		2		
CO3	3	2		1		
CO4	3	2		3		
CO5	3	3	3	3		
Total	15	11	3	10		
Average	3	2.2	0.6	2		

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fifth Semester				
Course Title		**COMPUTER PROGRAMMING IN C^{++}**		
Course Code		**22UEPHE1D**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CEC-1D	ELECTIVE	5	5	25+75=100

Course Objectives

The main objective of the course is

1. to provide knowledge about the basics of Computer programming in C++
2. to solve problems by writing programs.

UNIT I: **WHAT IS C^{++}** **15 hours**

Introduction - tokens - keywords - identifiers and constants - declaration of variables - basic data types - user defined data types-derived data types - symbolic constants - operators in C^{++} -expressions and their type-hierarchy of arithmetic operators- scope resolution operator – declaring, initializing and modifying variables-special assignment operators - all control structures-structure of a simple C ++ program

UNIT II:ARRAYS AND FUNCTIONS IN C^{++} **15 hours**

Introduction - one dimensional and two dimensional arrays-initialization of arrays-array of strings

Functions-introduction-function with no argument and no return values- function with no argument but return value - function with argument and no return values- function with argument and return values- call by reference-return by reference- function prototyping - inline functions - local, -global and static variables- -function overloading - virtual functions-main function-math library functions.

UNIT III:CLASSES AND OBJECTS **15 hours**

Introduction - specifying a class - defining member functions-C^{++} program with class - nesting of member functions - private member functions - objects as function arguments - arrays within a class-array of objects-static class members-friend functions-constructors - parameterized constructors-multiple constructors - constructors with default arguments - copy constructor.

UNIT IV: O**PERATOR OVERLOADING, INHERITANCE AND POINTERS** **15 hours**

Introduction -defining operator overloading - overloading unary operators - binary operators Inheritance - single inheritance - multiple inheritance - multilevel inheritance - hybrid inheritance - hierarchial inheritance-virtual base class-abstract classPointers- definition-declaration- arithmetic operations

UNIT V:MANAGING CONSOLE I/O OPERATIONS **15 hours**

Introduction - C^{++} stream - C^{++} stream classes - unformatted I/O Operations -formatted console I/O operations - working with files - classes for file steam operations - opening and closing a file - file pointers and their manipulations.

BOOK FOR STUDY:

1. E. Balagurusamy, Programming in ANSI C, Sixth Edition, McGraw Hill Education(India)Private Limited, New Delhi.

BOOKS FOR REFERENCE:

1. Schaum'sOutlines : Programming with C , Byron S. Gottfried, TataMcGraw Hill Pub. Co Ltd., New Delhi, 5/e, 2007
2. YashvantKanetkar, Programming with C,2nd edition, Tata McGraw Hill,New Delhi,1998.

Methodology of teaching:

Chalk and talk, powerpoint, Hands on training, Assignment, MCQs

COURSE OUTCOMES (COs)

Upon completion of the course the student will be able to

CO	Course Outcomes	K - Levels
CO1	Understand the basic elements in 'c'- programming.	K1, K2, K3
CO2	Aware of different types of operators and expressions in C language.	K1, K2, K3
CO3	Choose the loops and decision making statements to solve the problem	K2, K3, K4
CO4	Implement different operation an arrays and use function to solve the given problem	K2, K3, K4, K5
CO5	Gain the aptitude of solving logical problems	K3, K4, K5
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1		2		2	1	
CO2		2	3	2		
CO3		2	3	2		
CO4		2	3	2		
CO5	1	3	3		3	
Total	1	11	12	8	4	
Average	0.2	2.2	2.4	1.6	0.8	

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

SEMESTER-VI

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
CourseTitle		**NUCLEAR PHYSICS**		
Course Code		22UFPHC1		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-XI	Core	4	5	25+75=100

Course objectives:

The main objectives of this course are:

1.To obtain adequate knowledge in the concept of Nucleus
2.To study various Nuclear reaction - both experimental and theoretical studies
3.To understand difference among natural and artificial nuclear radioactivity
4.To study the nuclear accelerators/detectors and its limitations
5.To understand the basic concepts of elementary particles

UNIT I: Properties and structure of Nuclei **15 hours**

General properties of nucleus- binding energy – BE/A curve - significance -proton electron theory- proton neutron theory -Nuclear forces –characteristics –Meson theory of nuclear forces – Yukava Potential- Nuclear models- Liquid drop mode – semiempirical mass formula – Shell model (qualitative study only)

UNIT II: Radioactivity **15 hours**

Fundamental laws of radio activity –theory of α ,β and ϒ decay- properties of alpha, beta and gamma rays - neutrino and its properties-electron capture. - nuclear isomers- Mossbauer effect - applications- Radio carbon dating- raisotopes – uses.

UNIT III: Nuclear Reactions **15 hours**

Kinematics of nuclear reaction- Q value of nuclear reaction-types of nuclear reaction artificial transmutation-Nuclear fission –Nuclear fusion – Nuclear reactor-uses - atom bomb - hydrogen bomb-fusion reactor –plasma confinement

UNIT IV: Nuclear Detectors and Particle Accelerators **12 hours**

Neutron sources and properties- Detectors-G.M.Counter-scintillation counter-bubble chamber-Wilson cloud chamber-Accelerators-cyclotron-synchrocyclotron-betatron-synchrotrons – Proton synchrotron

UNIT V:Cosmic Rays and Elementary Particles **18 hours**

Cosmic rays-introduction-discovery-latitude, altitude and azimuth effects-longitudinal effect-north –south effect-seasonal and diurnal changes-primary and secondary cosmic rays-nature of cosmic rays- cosmic ray showers-Van Allen belt- origin of cosmic radiation. Elementary particles-introduction-particles and antiparticles-antimatter-the fundamental interaction-elementary particle quantum numbers-conservation laws and symmetry-the quark model

Books for study

1. Atomic and Nuclear Physics by N. Subrahmanyam and Brijlal, S Chand &Co.,New Delhi
2. Nuclear Physics by Tayal D.C., Himalaya Publishing House, Mumbai(2006).
3. Nuclear Physics by R.C.Sharma, K.Nath& Co., Meerut (2000)
4. Nuclear Physics by Irving Kaplan, Narosa Publishing house, New Delhi.

Books for Reference

1. Nuclear Physics by R.R.Roy and B.P.Nigam, New Age International (P) Ltd.,newDelhi(1997).
2. Fundamentals of Elementary Particle Physics by Longo, McGraw-Hill.
3. Nuclei and Particles by Serge., W.A. Benjamin, USA
4. Elements of Nuclear Physics by ML Pandya and RPS Yadav, Kedarnath Ram Nath,Meerut.

Web Site

http://faraday.physics.utoronto.ca/GeneralInterest/D.Bailey/SubAtomic/Lectures/Lect
nptel.iitm.ac.in

Methodology of teaching: chalk and talk, video presentations

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	Gain knowledge in the concepts of nuclear properties	K1, K2, K3
CO2	Understand radioactivity and its applications	K1, K2, K3
CO3	study on various Nuclear fission and Nuclear fusion reactions through experiments	K1, K2, K4
CO4	Study the limitation of various of source of accelerators and detectors in nuclear reactions	K1, K2, K4
CO5	Obtain knowledge of elementary particles concepts and cosmic rays	K1, K2, K3
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2			2	1
CO2	2	3			2	
CO3	2	1	2	2		
CO4	2	1			1	3
CO5	1	2	3	1		
Total	9	9	5	3	5	4
Average	1.8	1.8	1	0.6	1	0.8

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title		**SOLID STATE PHYSICS**		
Course Code		22UFPHC2		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-XII	Core	4	6	25+75=100

Course Objectives

The main objectives of this course are:

1. To understand the basic concepts of bonding in crystals
2. To know the concepts of lattice, crystal structure and diffraction
3. To acquire knowledge of magnetic phenomenon and the physics behind them
4. To analyze the dielectric properties of the material
5. To explore the concept of superconductivity with its application

UNIT I: Bonding in Solids **16 hours**

Types of bonds in crystals - Ionic, covalent, Metallic, Vander waal's and Hydrogen Bonding - Bond energy of sodium chloride molecule - variation of inter atomic force with inter atomic spacing -cohesive energy - cohesive energy of ionic solids

UNIT II: Crystal Structure and Crystal Diffraction **20 hours**

Crystal Lattice -Primitive and unit cell-seven classes of crystal-Bravais Lattice-Miller Indices-Structure of crystals-number of atoms per unit cell, co-ordination number, atomic radius, packing factor-Simple cubic, Face centered cubic, Body centered cubic and Hexagonal close packed structure -Sodium Chrloride, Zinc Blende and Diamond Structures. Crystal Diffraction – Bragg's law-Experimental methods-Laue method, powder method

UNIT III: Magnetic Properties **16 hours**

Spontaneous Magnetization –classical Theory of Diamagnetism – Weiss theory of Para magnetism – Ferromagnetic domains – Bloch wall – Basic ideas of anti-ferromagnetism – Ferrimagnetisms – Ferrites in computer Memories.

UNIT IV: Dielectric Properties **18 hours**

Band theory of solids –classification of insulators, Semiconductors, conductors – intrinsic and extrinsic semiconductor – Carrier concentration for electron - Polarization – frequency and temperature effects on polarization-dielectric loss-ClausiusMosotti relation-determination of dielectric constants.

UNIT V:Superconductivity **20 hours**

Introduction - General Properties of Superconductors - effect of magnetic field -Meissner effect - effect of current - thermal properties - entropy - specific heat -energy gap - isotope effect - Type–I and Type–II Superconductors - Explanation for the Occurrence of Super Conductivity - BCS theory - Application of Superconductors - High T_C superconductors.

Books for Study

1. Materials Science by M.Arumugam, Anuradha Agencies Publishers.,(2002).
2. Solid State Physics by R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003).
3. Introduction to Solid State Physics by Kittel, Willey Eastern Ltd(2003).
4. Materials Science and Engineering by V. Raghavan, Prentice Hall of India Private Ltd, (2004).

Books for Reference

1. Solid State Physics by S.O.Pillai, New Age International (P) Ltd.,(2002).
2. Solid State Physics by A. J.Dekker, Macmillan India(1985).
3. Solid State Physics by HC Gupta, Vikas Publishing House Pvt. Ltd., New Delhi

Web Site

http://folk.uio.no//dragos//solid/fys230-Exerciser.html.
http://www.physics.brocku.ca/courses/4p7d.
nptel.iitm.ac.in

Methodology of teaching: chalk and talk, video presentations

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K - Levels
CO1	Acquire the knowledge of fundamental interatomic forces and the bonds between them	K1, K2, K3
CO2	Analyze the concept of crystal systems and its diffraction pattern	K1, K2, K3, K4
CO3	Apply the laws and principles to understand the concept of magnetism	K1, K2, K3,K4
CO4	Summarize the classification of materials and dielectric nature of a material	K1, K2, K3
CO5	Explore the knowledge of superconductivity in various applications	K1, K2, K3
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1		1		
CO2	2	1	1	2		
CO3	1	2	1	2		
CO4	2	1	1		1	
CO5	2	1		1		1
Total	9	6	3	6	1	1
Average	1.8	1.2	0.6	1.2	0.2	0.2

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title		**Major Practical – III** (Practical exam at the end of VI semester)		
Course code		22UFPHC3		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-XIII	CORE PRACTICAL	4	3	40+60=100

Course Objectives:

The main objectives of this course are:

1. Introduce students to the methods of Experimental Physics
2. Translate the concepts learnt in the lecture sessions to the laboratory sessions
3. Provide hands on experience in measuring the basic concepts in properties of Matter, Heat, Sound, Optics, Electricity and Magnetism
4. Develop skill in setting up the experiments, data analysis and accuracy of measurements
5. Plot graphs for better understanding and do error analysis

1. Young's modulus - Non uniform Bending - Koenig's method
2. Tan C position- Determination of m and BH
3. Spectrometer - Small angled prism - Normal incidence and emergence- refractive index of the material of a prism
4. Spectrometer - (i - i') curve - refractive index of the material of a solid prism
5. Spectrometer - Cauchy's constants- A and B
6. Spectrometer – Dispersive power of grating
7. Newton's rings – Refractive index of the material of the convex lens
8. Newton’s rings – refractive index of liquid
9. Field along axis of a circular coil–Deflection magnetometer– Determination of M
10. Field along axis of a circular coil–Deflection magnetometer -Determination of B_H
11. Carey Foster’s bridge –Resistance and specific resistance of a coil
12. Potentiometer - Calibration of high range voltmeter
13. Potentiometer – Temperature coefficient of resistance of a coil
14. B.G - Figure of merit (quantity of charge)
15. B.G - Comparison of EMF’s
16. B.G - Comparison of capacitances

Books for reference:

1.A text book of practical physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan
2. Practical Physics and Electronics by C.C.Ouseph, U.J.Rao and Vijayendran, S.Viswanathan (Printers & Publishers) Pvt., Ltd (2007).

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Apply knowledge of mathematics and physics fundamentals and an instrumentation to arrive solution for various problems	K1, K2, K3, K4
CO2	Use standard methods to calibrate the given high range voltmeter and use BG for measuring various electrical quantities	K1, K2, K3, K4
CO3	Understand the usage of basic laws and theories to determine various properties of the matter given, spectral properties and optical properties of materials	K1, K2, K3, K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	3		
CO2	2	2	1	3		
CO3	2	2	1	3		
Total	6	6	3	9		
Average	1.2	1.2	1	3		

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title		**Major Practical – IV** (Practical exam at the end of VI semester)		
Course Code		22UFPHC4		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal+ External)**
CC-XIV	CORE PRACTICAL	4	3	40+60=100

Course Objectives:

The main objectives of this course are:

1. Introduce students to the methods of Basic Electronics
2. concepts learnt in the lecture sessions to the laboratory sessions
3. Provide hands on learning experience in constructing the circuits
4. Develop skill in electronics

1. IC regulated power supply – study of regulation properties – IC 7805
2. Bridge rectifier - Zener regulated power supply - 9V characteristics
3. Phase shift oscillator using transistor
4. Transistor Characteristics – Common Emitter Mode
5. Transistor Characteristics – Common Base Mode
6. Wien's Bridge Oscillator – measurement of frequency
7. FET characteristics – Determination of parameters
8. FET Amplifier – Frequency response
9. UJT characteristics – Determination of parameters
10. Transistor –Astablemultivibrator
11. AND, OR, NOT gates using diode and transistor
12. NAND as universal gate
13. Half Adder – Full adder – (IC 7400)
14. Half Subtractor – Full subtractor – (IC 7400)
15. NOR as Universal gate

Books for reference:

1.A text book of practical physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan

2. Practical Physics and Electronics by C.C.Ouseph, U.J.Rao and Vijayendran, S.Viswanathan (Printers & Publishers) Pvt., Ltd (2007).

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Construct and verify basic logic gates	K1,K2
CO2	Illustrate realization of Boolean expression in SOP and POS form	K1,K2
CO3	Determine various parameters	K1,K2
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1		1			
CO2	1		1			
CO3	1		1			
Total	3		3			
Average	1		1			

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title		**Major Practical – V** (Practical exam at the end of VI semester)		
Course Code		22UFPHC5		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CC-XV	CORE PRACTICAL	4	3	40+60=100

Course Objectives:

The main objectives of this course are

1. To expose students to the operation of typical Microprocessor (8085) trainer kit
2. To apply the programming knowledge for mathematical operations to solve different problems by developing types of programs
3. To develop the quality of assessing and analyzing the obtained data.
4. To apply the concepts of Integrated electronics in designing analogue and digital circuits
5. To familiarize students oscillators, multivibrators and digital to analog conversioins using integrated chips with passive components

1. Microprocessor – 8085 – 8 bit Addition& 8 bit Subtraction
2. Microprocessor – 8085 – 16 bit Addition & 16 bit Subtraction
3. Microprocessor – 8085 – 8 bit Multiplication& 8 bit Division
4. Microprocessor – 8085 – Sorting of given set of numbers in ascending & descending order
5. Microprocessor – 8085 – Finding the largest & smallest numbers in a given set of numbers
6. Microprocessor – 8085 – Square of a single byte hexa number
7. Op amp IC741 - Inverting , Non - Inverting amplifier, unity follower.
8. Op amp IC 741 - Summing and difference amplifier
9. Op amp IC 741 – Differentiator, integrator
10. Op amp IC 741 – Wein's Bridge oscillator
11. IC 555 - Timer - Schmitt Trigger
12. IC 555 – Timer – Astablemultivibrator
13. IC 555 – Timer –Monostablemultivibrator
14. D/A Converter – 4 bit, binary weighted resistor method

15. D/A Converter – R-2R Ladder Method

Books for the Study &Reference :

1. Practical Physics by D. Chattopadhyay, P.C. Rakshit, New Central Book Agency (p) Ltd. Kolkata(2007).
2. Practical Physics and Electronics by C.C.Ouseph, U.J.Rao and Vijayendran, S.Viswanathan (Printers & Publishers) Pvt., Ltd (2007).
3. Practical Physics by C L Arora, S. Chand & Co., New Delhi (2008)

COURSE OUTCOMES (COs)

Upon completion of this course, the student will be able to

CO	Course Outcomes	K - Levels
CO1	Understand the fundamentals and importance of assembly level programming of Microprocessor 8085 and practicing different types of programming.	K1, K2, K3
CO2	Develop testing and experimental procedures on microprocessor to analyse their operation under different cases	K2, K3, K4
CO3	Ability to test the fundamental understanding of Oscillators, multivibrations, Digital to analog conversions using Operational amplifier and 555 Timer circuits	K1, K2, K4, K5
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1			
CO2	2		2			
CO3	2	1		1		
Total	6	2	3	1		
Average	1.67	0.66	1	0.33		

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title	**ENERGY PHYSICS**			
Course Code	**22UFPHE2A**			
Course no.	Course category Core/Elective	No. of Credits	No. of hrs/week	Total marks (Internal+External)
CEC-IIA	**Core Elective**	**5**	**5**	**25+75=100**

Course Objectives:

The main objectives of this course are:

1. To acquire required knowledge in the concept of energy
2. To study the energy storage devices - experimental and theoretical studies.
3. To analysis evolution of renewable energy sources
4. To find the solution for the energy crisis using wind energy.
5. To apply the energy conversion techniques to solve the problem of energy requirement

UNIT I: Introduction to Energy Sources **15 hours**

World's reserve of Commercial energy sources and their availability-India's production and reserves-Conventional and non-conventional sources of energy, comparison – Coal- Oil and natural gas –applications - merits and demerits.

UNIT II: Solar Thermal Energy **15 hours**

Solar constant -Solar spectrum-Solar radiations outside earth's atmosphere –at the earth surface- on tilted surfaces -Solar Radiation geometry-Basic Principles of flat plate collector – Materials for flat plate collector -Construction and working- Solar distillation–Solar disinfection - Solar drying-Solar cooker(box type)-Solar water heating systems – Swimming pool heating.

UNIT III: Photovoltaic Systems **15 hours**

Introduction-Photovoltaic principle-Basic Silicon Solar cell- Power output and conversion efficiency-Limitation to photovoltaic efficiency-Basic photovoltaic system for power generation-Advantages and disadvantages-Types of solar cells-Application of solar photovoltaic systems - PV Powered fan – PV powered area lighting system – A Hybrid System.

UNIT IV: Biomass Energy **15 hours**

Introduction-Biomass classification- Biomass conversion technologies-Bio-gas generation-Factors affecting bio-digestion -Working of biogas plant- floating and fixed dome type plant -advantages and disadvantage of -Bio-gas from plant wastes-Methods for obtaining energy from biomass- Thermal gasification of biomass-Working of downdraft gasifier-Advantages and disadvantages of biological conversion of solar energy.

UNIT V: Wind Energy and Other Energy Sources **15 hours**

Wind Energy Conversion-Classification and description of wind machines, wind energy collectors-Energy storage-- Energy from Oceans and Chemical energy resources-Ocean thermal energy conversion-tidal power, advantages and limitations of tidal power generation-Energy and power from waves- wave energy conversion devices- Fuel cells- and application of fuel cells-batteries- advantages of battery for bulk energy storage- Hydrogen as alternative fuel for motor vehicles.

Books for study

1. Kothari D.P., K.C. Singal and RakeshRanjan, Renewable energy sources and emerging Technologies, Prentice Hall of India, 2008.
2.Solar Energy-principles of thermal collection and storage-S.P.SUKHAME-tata-McGraw-Hill publishing company ltd.

Books for References

1. Chetan Singh Solanki, Solar Photvoltaics Fundamentals, Technologies andApplications, 2ndEdition, PHI Learning Private Limited, 2011.
2. Rai G. D, Non conventional Energy sources, 4th Edition, Khanna Publishers,2010.
3. Jeffrey M. Gordon, Solar Energy: The State of the Art, Earthscan, 2013.
4. Kalogirou S.A., Solar Energy Engineering: Processes and Systems , 2nd Edition, Academic Press, 2013.
5. ZobaaA.F.and Ramesh Bansal, Handbook of Renewable EnergyTechnology, World Scientific, 2011.

Methodology of Teaching:

Chalk and talk, video presentations, industrial visit

Website:

nptel

COURSE COUTCOMES (COs)

Upon completion of this course, the student will be able to

CO	Course Outcomes	K-Level
CO1	Gain knowledge in the concept of Energy	K1, K2, K3, K4
CO2	Evaluate ideas about the energy conversion	K1, K2, K3
CO3	Recognize basic teams in the energy physics and different energy conversion process	K1, K2, K3, K4
CO4	Formulate basic theoretical problems in the energy crisis and solve them through energy conversion	K1, K2, K3
CO5	Apply energy conversion technique to solve problem pertaining to energy in sufficiency	K1, K3,K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2				1
CO2	2	1				
CO3	2	1	1	2		
CO4	2	1			1	
CO5	3	2	3	2		2
Total	11	7	4	4	1	3
Average	2.2	1.4	0.8	0.8	0.2	0.6

Level of Correlation between PSO's and CO's
Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title	**NANO PHYSICS**			
Course Code	**22UFPHE2B**			
Course no.	Course category Core/Elective	No. of Credits	No. of hrs/week	Total marks (Internal+External)
CEC-IIB	**Core Elective**	**5**	**5**	**25+75=100**

Course Objectives

The main objectives of this course are

1. To create the basic knowledge in nano materials.
2. To understand the scientific perspective of nanomaterials.
3. To identify the techniques suitable for nanomaterial synthesis.
4. To know the significance of nanomaterials.

UNIT I:Nanomaterials **15 hours**

History of Nanotechnology- Nanostructures- synthesis of oxide nano particles- Synthesis of semiconductor nano particles- Synthesis of metallic nano particles

UNIT II: Quantum Hetero structure **15 hours**

Super lattice- preparation of Quantum nanostructure- Quantum well laser- Quantum cascade laser-Quantum wire- Quantum dot- Application of Quantum dots.

UNIT III: Carbon Nanotubes

Discovery of Nanotubes- Carbon Allotropes- Types of carbon Nanotubes- Graphene sheet to a single walled nanotube- Electronic structure of Carbon Nanotubes- Synthesis of Carbon Nanotube.

UNIT IV Nanocrystalline Materials **15 hours**

Nanocrystalline soft material- Permanent magnet material- Theoretical background- Super paramagnetism- Coulomb blockade-Quantum cellular Automata.

UNIT V: Application of Nanotechnology **15 hours**

Chemistry and Environment – Energy applications of nanotechnology- Information and Communication- Heavy industry-Consumer goods- Nanomedicine - Medical application of Nanotechnology

Books for Study

1) Text book of Nanoscience and Nanotechnology – B. S. Moorthy, P. Sankar, Baldev Raj, B. B. Rath and James Murdy University Press – IIM

2) Nanophysics, Sr. GeradinJayam, Holy Cross College, Nagercoil (2010)

Books for Reference:

1) 'Nanoscience and Nanotechnology: Fundamentals to Frontiers' M.S. RamachandraRao, Shubra Singh, Wiley India pvt. Ltd., New Delhi. (2013).
2) 'Nano the Essentials' - T. Pradeep, Tata Mc.Graw Hill company Ltd (2007)
3) '*The Chemistry of Nano materials : Synthesis, Properties and Applications*', Volume 1 C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, , Germany (2004).

Website:

nptel

Methodology of Teaching:

Chalk and talk, video presentations, Research Lab visit

COURSE OUTCOMES (COs)

Upon completion of the course the student will be able to

CO	Course Outcomes	K - Levels
CO1	Gain basic knowledge about nano materials	K1, K2, K3
CO2	Understand the scientific perspective of nanomaterials	K1, K2, K3
CO3	Identify techniques suitable for nanomaterial synthesis.	K1, K2, K3
CO4	know the significance of nanomaterials in everyday life	K1, K2, K3, K4
CO5	Apply the knowledge for further research	K3, K4
K1 – Remembering , **K2**– Understanding , **K3** –Applying ,**K4** –Analysing , **K5**–Evaluating , **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2				1
CO2	2	2				1
CO3	2	2		2		1
CO4	2	2	2		3	3
CO5		3	2	3		
Total	9	11	4	5	3	6
Average	1.8	2.2	0.8	1	0.6	1.2

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title		**OPTOELECTRONICS**		
Course Code		**22UFPHE3A**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CEC- IIIA	Elective	5	5	25+75=100

Course Objectives

The main objectives of this course are

- To give an introductory account of the basic principles of Optoelectronic devices
- To understand the principle and working of LASER
- To gain information about fibre optic communication

Unit I **15 hours**

Introduction – PN junction as a Light Source (LED) – LED materials – Advantages – LCD - Characteristics and action of LCD – Advantages.

Unit II **15 hours**

Laser- Introduction– characteristics of Laser– Spontaneous and stimulated emission– Einstein coefficients- condition for population inversion– three level scheme– semi conductorlaser

Unit III **15 hours**

Photo detector- characteristics of photo detectors– PN junction photo detector– PIN photo diode- Avalanche photo diode- Photo transistor.

Unit IV **15 hours**

Introduction – principle of optical fibre – light transmission in a optical fibre – Acceptance angle – Numerical aperture.

Unit V **15 hours**

Fibre index profiles – Step index, graded fibre (transmission of signals) – Advantages of fibre optic communications, optical switching

Books for study

1. Semiconductor physics and Optoelectronics – P. K. Palanisamy, SCITECH Publication, Chennai 2002.
2. Optical fibres and Fibre Optic Communication – Sabir Kumar Sarkar IV Revised Edition 2003.

Books for reference:

1. Opto Electronics – Wilson & Hawker, Prentice Hall of India 2004.

Website: nptel.iitm.ac.in

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to

CO	Course Outcomes	K - Levels
CO1	Understand the fundamental process of optoelectronic transitions and characterization	K1, K2, K3, K4
CO2	Utilize the concepts of laser to different optoelectronic devices	K1, K2, K3
CO3	Design and analyze photo detectors from semiconductor optoelectronic devices	K1, K2, K3, K4
CO4	Demonstrate the basic requirements of optical fiber	K1, K2, K3,
CO5	Apply the principles of fiber optic communication in everyday life	K1, K2, K3
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2				1
CO2	2	2				1
CO3	2	2		2		1
CO4	2	2	2		3	3
CO5		3	2	3		
Total	9	11	4	5	3	6
Average	1.8	2.2	0.8	1	0.6	1.2

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Sixth Semester				
Course Title		**MEDICAL PHYSICS**		
Course Code		**22UFPHE3B**		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
CEC- IIIB	Elective	5	5	25+75=100

Course Objectives

The main objectives of this course are:

1. To understand basics about the biological systems in our body and their behaviour
2. To gain knowledge on the diagnostic devices
3. To apply the inventions of physics in diagnosis

UNIT I **15 hours**

Basic Anatomical Terminology- Standard anatomical position, Planes, Familiarity with terms like – Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal, Distal. – Forces on and in the Body – Physics of the Skeleton – Heat and Cold in Medicine- Energy work and Power of the Body.

UNIT II **15 hours**

Pressure system of the body- Physics of Cardiovascular system- Electricity within the Body – Applications of Electricity and Magnetism in Medicine. Sound in medicine- Physics of the Ear and Hearing- Light in medicine- Physics of eyes and vision.

UNIT III **15 hours**

Transducers- performance of characteristics of transducer- static and dynamic active transducers – (a) magnetic induction type (b) piezoelectric type (c) photovoltaic type (d) thermoelectric type. Passive transducer- (a) resistive type – effect and sensitivity of the bridge (b) capacitive transducer (c) linear variable differential transducer (LVDT)

UNIT IV **15 hours**

X-rays- Production of X-rays- X-ray spectra- continues spectra and characteristic spectra- Coolidge tube- Electro Cardio Graph (ECG) - Block diagram- ECG Leads- Unipolar and bipolar- ECG recording set up.

UNIT V **15 hours**

Electro Encephalo Graph (EEG) - origin- Block diagram- Electro Myogragh (EMG) – Block diagram- EMG recorder- Computer Tomography (CT) principle- Block diagram of CT scanner.

Books for Study:

1. Medical Physics –John R. Cameron and James G.Skofronick, 1978, John Willy & Sons.
2. Bio medical instrumentation – E D II, Dr M. Arumugam, Anuradha Agencies 1997.

Website:

nptel.iitm.ac.in

Methodology of Teaching:

Chalk and talk, video presentations, hospital visit

COURSE OUTCOMES (COs)

Upon completion of the course the student will be able to

CO	Course Outcomes	K - Levels
CO 1	Understand the biological system of our body	K1, K2
CO 2	Acquire the major aspects of medical physics and the application of physics to medicine.	K1, K2, K4
CO 3	Define different quantitative, mathematical science and physical tools to analyze problems	K2, K3, K4
CO 4	Interpret the data obtained from testing, diagnostic instruments such as X-rays, ECG, EMG, EEG, ultrasonic images, and CT images	K2, K3, K4
CO 5	Work independently and demonstrate the ability to manage time and to work as a part of a team, and learn independently with open–mindedness to learn how solve the daily life problems.	K3, K4, K5
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1		1		
CO2	2					
CO3	2		3	2		
CO4	3	3	2	3		3
CO5		3	2	3	3	3
Total	8	7	7	9	3	6
Average	1.6	1.4	1.4	1.8	0.6	1.2

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN

UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

ALLIED COURSES

B.Sc. DEGREE PROGRAMME IN PHYSICS

Third Semester				
Course Title		**ALLIED PHYSICS-I (THEORY)**		
Course Code		**22UCPHA1**		
Course No	**Course Category Core/Elective**	**No of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
AC-I	Allied	4	4	25+75=100

Course Objectives:

The main objectives of this course are:

1. To enable the students to gain knowledge of the properties of matter
2. To make the students effectively achieve an understanding of surface tension and viscosity of liquids
3. To introduce the basics of conduction, convection and radiation
4. To instill the knowledge on the laws of thermodynamics
5. To establish a sound grasp of knowledge on the basic properties of light.

UNIT I: Properties of Matter **12 hours**

Young's modulus – Rigidity modulus – Bulk modulus – Poisson's ratio (definition alone) – Bending of beams – Expression for bending moment – determination of young's modulus – non-uniform bending (theory and experiment)

Expression for Couple per unit twist – work done in twisting a wire – Torsional oscillations of a body– Rigidity modulus of a wire by torsion pendulum.

UNIT II: Surface tension and Viscosity **12 hours**

Surface tension – molecular theory of surface tension – drop weight method- interfacial surface tension

Viscosity – Viscous force – Co-efficient of viscosity – units and dimensions – Poiseuille's formula for co-efficient of viscosity of a liquid – determination of co-efficient of viscosity using burette and comparison of Viscosities

UNIT III: Conduction, Convection and Radiation **12 hours**

Specific heat capacity of solids and liquids – Dulong and Petit's law – Newton's law of cooling – Specific heat capacity of a liquid by cooling – thermal conduction –coefficient of thermal conductivity by Lee's disc method.Convention process – Lapse rate – green house effect – Black body radiation – Planck's radiation law – Rayleigh Jean's law, Wien's displacement law – Stefan's law of radiation. (No derivations).

UNIT IV: Thermodynamics **12 hours**

Zeroth and I Law of thermodynamics – II law of thermodynamics – Carnot's engine and Carnot's cycle – Efficiency of a Carnot's engine – Entropy – Change in entropy in reversible and irreversible process – change in entropy of a perfect gas

UNIT V: Optics **12 hours**

Interference – Interference in thin films - air wedge – determination of thickness of a wire – **Diffraction** – Fresnel &Fraunhofer diffraction - Fresnel's explanation of rectilinear propagation of light – Determination of wavelengths of spectral lines of mercury spectrum using plane transmission grating.

Polarisation – polarization by reflection - double refraction – Nicol prism as polarizer and analyser

Books for Study and Reference

1. Properties of matter – Brijlal and Subramanyam – Eurasia Publishing co., New Delhi, 1983.
2. Element of properties of matter – D.S.Mathur – S.Chand& Company Ltd, New Delhi, 1976
3. Heat and Thermodynamics–Brijlal&Subramanyam, S.Chand& Co, 16th Edition 2005
4. Heat and Thermodynamics – D.S. Mathur, SultanChand& Sons, 5th Edition 2014.
5. Optics and Spectroscopy –R.Murugeshan, S.Chand and co., New Delhi, 6thEdition 2008.

Website:

www.core.org.cn/ocw web/physics/8-311 spring 2004/lecture notes.
nptel.iitm.ac.in

Methodology of Teaching:

Chalk and talk, hands on learning, video presentations

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Understand the various moduli involved in the materials	K1, K2, K3
CO2	Know about the forces acting on liquids due to surface tension and viscosity	K1, K2, K3
CO3	Develop basic understanding about the transmission of heat due to the process of conduction, convection and radiation	K1, K2, K3, K4, K5
CO4	Comprehend and apply various laws of thermodynamics and the concept of entropy for many everyday phenomena	K1, K2, K3, K4
CO5	Understand the applications if interference, diffraction and polarisation in the areas relating to Optics	K1, K2, K3
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2		2	2		2
CO2	2		1	2		
CO3	2		1			3
CO4	2		1	1		
CO5	2			2		
Total	10		5	7		5
Average	2		1	1.2		1

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fourth Semester				
Course Title		**ALLIED PHYSICS – II (THEORY)**		
Course Code		22UDPHA2		
Course No	**Course Category Core/Elective**	**No. of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
AC-II	Allied	4	4	25+75=100

Course Objectives (COs):

The main objectives of this course are:

1. To enable the students to understand the aspects of current electricity
2. To provide comprehensive knowledge and understanding of the basics of Electricity and Magnetism
3. To provide an introductory account about the atomic structure and nuclei
4. To enable the students to understand the aspects of analog electronics ina lucid and comprehensive manner
5. To acquire knowledge on number system and concepts of logic gates

UNIT I: Current Electricity **12 hours**

Ohm's law – Law of resistance in series and parallel – Specific resistance – capacitors – capacitors in serial and parallel – Kirchoff's laws – Wheatstone's network – condition for balance

Carey-Foster's bridge – measurement of resistance – measurement of specific resistance – determination of temperature coefficient of resistance – Potentiometer – calibration of Voltmeter.

UNIT II: Electromagnetism **12 hours**

Electromagnetic Induction – Faraday's laws – Lenz law – Self Inductance – Mutual Inductance – Coefficient of Coupling

A.C. Circuits – Mean value – RMS value – Peak value – LCR in series circuit – impedance – resonant frequency – sharpness of resonance.

UNIT III: Atomic and Nuclear Physics **12 hours**

Bohr's atom model – radius energy – Atomic excitation – Ionization potential – Frank and Hertz Method – Nucleus – Nuclear properties – Mass defect – Binding energy.

Radio isotopes – Uses of radio isotopes – Nuclear fusion and Nuclear fission – X-rays – Production – properties –Derivation of Bragg's law – uses in industrial and medical fields.

UNIT IV: Analog Electronics **12 hours**

Semiconductor – PN junction diode – Bridge rectifier – Zener diode – Regulated power supply.

Transistor – Working of a transistor – CE Configuration – current gain relationship between α and β – Transistor Characteristics – CE Configuration only.

UNIT V: Digital Electronics **12 hours**

Number system – Decimal – Binary – Octal and Hexadecimal system – Double Dabble method – Binary addition, subtraction and multiplication – conversion of one number system to another number system.

Logic gates – OR, AND, NOT, XOR, NAND and NOR gates – truth tables – NAND and NOR as universal gates – Laws and theorems of Boolean's algebra – De Morgan's theorems.

Books for Study and Reference:

1. Electricity and Magnetism – R. Murugesan, S. chand& co, 2001.
2. Modern Physics – R. Murugesan, S. chand& co, 1998.
3. Basic Electronics – B.L.Theraja, S. chand& co, 2003.

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Apply the knowledge of current electricity to technological advances	K1, K2, K3
CO2	Gain knowledge on the fundamental principles of electricity and magnetism and its applications in everyday life	K1, K2, K3
CO3	Acquire sufficient knowledge on the properties of atoms and nuclei and its applications	K1, K2, K3
CO4	Understand fundamental principles of semiconductors, p-n junction diode, zener diode and transistors and its applications in electronic devices	K1, K2, K3
CO5	Understand the structure of various number systems and basic logic gates and its applications in computers	K1, K2, K3, K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2		2			2
CO2	2		1			2
CO3	2		1			
CO4	2		1			2
CO5	2	1	2		1	2
Total	10	1	7		1	8
Average	2	.2	1.2		.2	1.6

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0

BLOOM TAXANOMY BASED QUESTION PAPER PATTERN
UG Degree Pattern

Knowledge Level	Section	Marks	Description	Total Marks
K1,K2,K3,K4	A (Answer all the questions)	10 × 2	Short Answer (Two questions from each unit)	20
K1, K2, K3,K4	B (**INTERNAL CHOICE**) EITHER (a) OR (b)	5 × 5	Question (a) and (b) from the same Unit and same K Level	25
K2,K3, K4, K5	C (Answer any three question from five questions)	3 × 10	One question from each unit (No unit missing)	30
Grand Total				**75**

B.Sc. DEGREE PROGRAMME IN PHYSICS

Fourth Semester				
Course Title		**ALLIED PHYSICS PRACTICAL** (At the end of the Fourth semester)		
Course Code		22UDPHA3		
Course No	**Course Category Core/Elective**	**No of Credits**	**No. of hrs/week**	**Total Marks (Internal + External)**
ACP	ALLIED practical	4	3	40+60=100

Course Objectives:

The main objectives of this course are:

1. Introduce students to the methods of Experimental Physics
2. Translate the concepts learnt in the lecture sessions to the laboratory sessions
3. Provide hands on experience in measuring the basic concepts in properties of Matter, Heat, Sound, Optics, Electricity and Magnetism
4. Develop skill in setting up the experiments, data analysis and accuracy of measurements
5. Plot graphs for better understanding and do error analysis

1. Youngs's modulus by non uniform bending - pin and microscope
2. Youngs's modulus by non uniform bending using Optic lever -scale & telescope
3. Surface tension and interfacial surface tension - drop weight
4. Air wedge – determination of thickness of a thin wire
5. Potentiometer – Calibration of low range voltmeter
6. Post office box – Resistance and specific resistance
7. Figure of merit – Spot galvanometer(or) table galvanometer
8. Construction of AND, OR gates using diodes and NOT gate using transistor
9. Transistor characteristics – Common emitter mode
10. Comparison of viscosities –Burette method
11. Rigidity modulus– Torsion pendulum
12. Determination of wavelength using diode laser source
13. NAND as universal gate
14. NOR as universal gate

Note: Use of Digital Balance is permitted

Books for study and reference

1.Allied practical physics - M.Srinivasan, S.Chand& Co.
2.Allied Practical Physics – M. Arul Thalapathi, Comptek Publishers (2003)
3.Practical physics and electronics - C.C.Ouseph, U.J.Rao, V. Vijayendran- S.Viswanathan (Printers & Publishers), Pvt.Ltd.

COURSE OUTCOMES (CO):

Upon completion of this course, the students will be able to:

CO	Course Outcomes	K – Levels
CO1	Understand the usage of basic laws and theories to determine various properties of the matter given	K1, K2, K3, K4
CO2	Use standard methods to calibrate the given low range voltmeter and to measure resistance of the given coil and various physical quantities	K1, K2, K3, K4
CO3	Design basic analog and digital circuits and study its characteristics	K1, K2, K3, K4
K1 – Remembering, **K2**– Understanding, **K3** –Applying, **K4** –Analysing, **K5**–Evaluating, **K6**–Creating		

CO-PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	3		
CO2	2	2	1	3		
CO3	2	2	1	3		
Total	**6**	6	3	9		
Average	**2**	2	1	3		

Level of Correlation between PSO's and CO's

Low : 1
Medium : 2
High : 3
No Correlation: 0